Hermann PLAUSON

Conversion of Atmospheric Electricity

http://en.wikipedia.org/wiki/Hermann_Plauson

Biography

Hermann Plauson was an Estonian engineer and inventor. Plauson investigated the production of energy and power via atmospheric electricity.

Plauson was the director of the Fischer-Tropsch "Otto Traun Research Laboratories" in Hamburg, Germany during the Weimar Republic of the 1920s. He built on Nikola Tesla's idea for connecting machinery to the "wheelwork of nature". Plauson's US Patent # 1,540,998 describes methods to convert alternating radiant static electricity into rectified continuous current pulses. He developed the Plauson's converter, an electrostatic generator. In 1920, Plauson published a book titled "*Production and Utilization of the Atmospheric Electricity*" (*Gr., Gewinnung und Verwertung der Atmospharischen Elektrizitat*). A copy of this book is in the British Library.

It is believed that he was related to Gertrud Plauson (the exact relationship is unknown; she may be his wife).

"Power from the Air". *Science and Invention* , Feb. 1922, no. 10. Vol IX, Whole No. 106. New York. (nuenergy.org)
"Power from the Air". *Science and Invention* , March 1922.

***Science and Invention,* Vol. IX (106) #10 (February 1922)**

Power from the Air (I)

by

Hugo Gernsback

During the war there was developed in Germany a new art --- or science --- that bids fair to revolutionize our present means of obtaining power.

This art, which is as new now as wireless was 25 years ago, will attain proportions during the next 25 years that may appear fantastic today. The inventor of the new science, an engineer of note, Herr Hermann Plauson, has devoted years of labor to his researches and he has now actually in use small power plants, that generate electricity direct from the air, day and night, without interruption at practically no cost, once the plant is constructed.
We had occasion, in one of our former issues, to describe the system, roughly, from cabled dispatches, but complete information is available now. The amount of electrical power that resides in our atmosphere is astounding. Herr Plauson found in his experiments that a single balloon sent aloft to a height of 300 yards gave a constant current at 400 volts of 1.8 amperes, or in 24 hours over 17-1/4 kilowatts! By using two balloons in connection with a special condenser battery, the power obtained was 81-1/2 kilowatts in 24 hours. The actual current delivered was 6.8 amperes at 500 volts.

The best balloons used by the inventor are made of thin aluminum leaf. No fabric was used. A simple internal system of ribs, stays and wires, gives the balloon rigidity as well as a certain amount of elasticity. The balloon, when made airtight, is filled with hydrogen or better, with helium. It will then stay aloft for weeks at a time. The outer surface is dotted with extremely sharp pins, made sharp electrolytically. Ordinary pins did not prove good current collectors, as they lacked extreme sharpness. The pins themselves were made from amalgamated zinc, containing a radium preparation, in order to ionize the air. It was also found that by dotting the outer surface of the balloon with zinc-amalgam more current could be collected. Even better results were obtained with polonium amalgam. Plauson states that the function of these amalgams is purely photoelectric.

One hundred of such captive balloons, separated one hundred yards from each other, will give a steady yield of 200 horsepower. This is the minimum, because in the winter this figure increases up to 400 horsepower, due to the higher electrification of the atmosphere.

We need not go into the technic of how the current is finally made useable for industrial purposes, suffice it to say that the problem has been entirely solved by Herr Plauson. By using batteries of condensers, high tension transformers, etc., the current can be transformed to any form desires. Such as for lighting lamps, running motors, charging storage batteries, etc.

Plauson also invented a sort of electrostatic rotary transformer which gives alternating current without the use of condensers and transformers. Indeed, its output is very great, as it actually ‘sucks’ the current down rapidly from the collector balloons. There is no doubt that this invention will soon come into universal use all over the world. We will see the land dotted with captive balloons, particularly in the country and wherever water power does not abound. Indeed, the time is not distant when nearly all of our power will be derived from the atmosphere. So far it seems to be the cheapest form of power known, it being much cheaper even than water power --- the cheapest form of power known today. Not only that, but as the inventor points out, no devastating thunder storms occur near such aerial power plants, because the balloons act not only as lightning arresters, but they quickly discharge the biggest thunder cloud, safely and noiselessly through their grounded spark gaps.

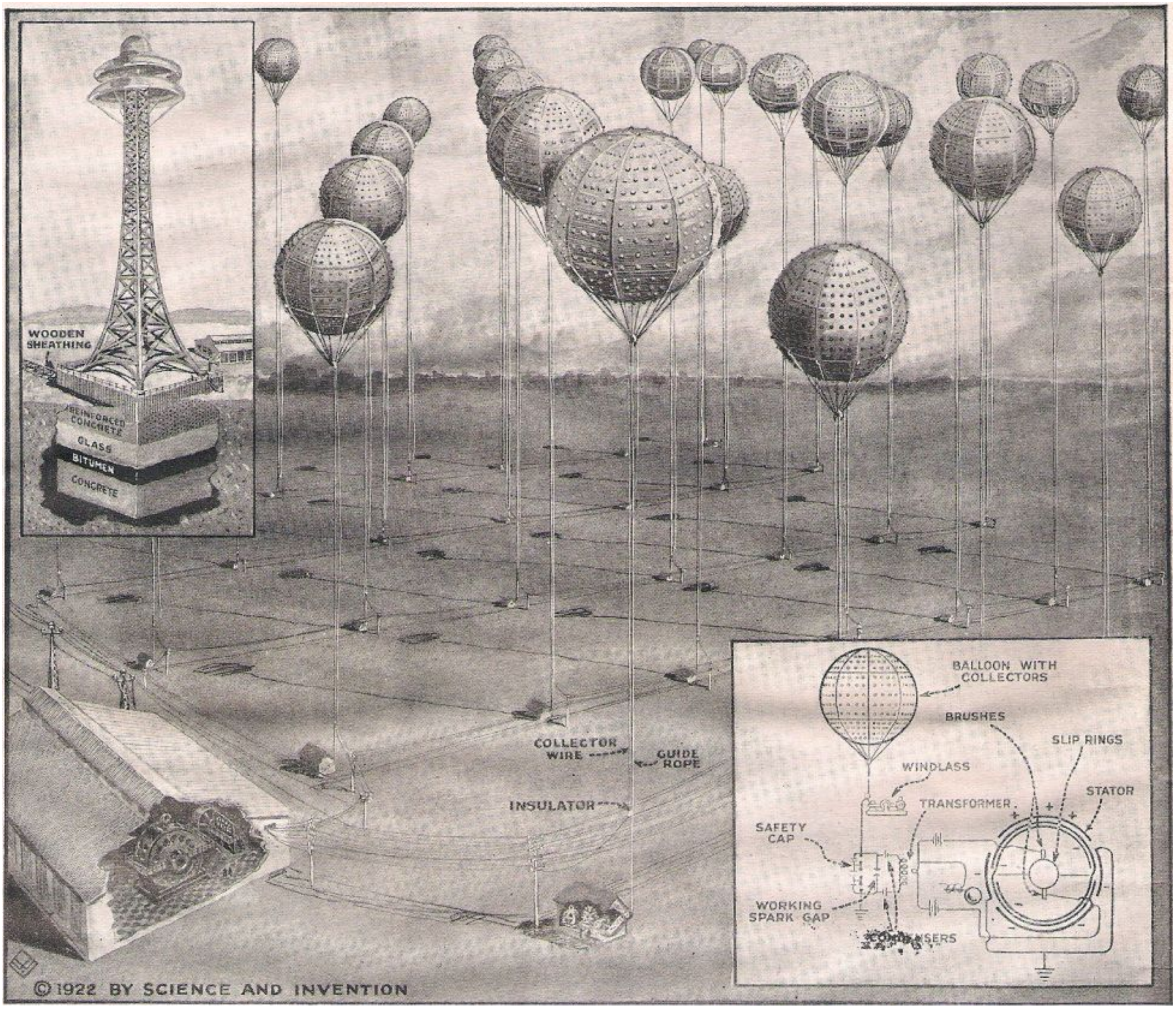
Science & Invention **(March 1922), page 1006, 1007**

Power from the Air (II)

by

Hugo Gernsback

[For many years electrical engineers have endeavored to devise some means whereby it would become possible to utilize the free electrical energy ever present in the atmosphere, but they were not successful, as every now and then an extra heavy surge of static current would rush down the elevated conductor and endanger the lives of the experimenters, or else destroy the apparatus connected with it. A German engineer has, however, devised the somewhat elaborate scheme here shown in brief, and he has succeeded, at least so his report states, in safely extracting several kilowatts of electrical power from the atmosphere with metallic surfaced balloons, elevated to a height of only 1000 feet.]



We have previously treated of the extraction of electrical energy from the atmosphere. The difference of electric potential in different parts of the atmosphere, and the difference between the upper air and earth make it a tempting proposition to obtain power from atmospheric electricity. The power would take the form of high potential difference with a discharge almost of a static nature. It has long appeared rather doubtful to conservative engineers, if such a source of power should really be available. Yet when we see the lightning flash, it certainly suggests very high power, even though the total of its energy may be small, on account of the small duration of the discharge It is not to the thunder storm that we look for getting power from the atmosphere, as the subject is now being seriously investigated. A German scientist, Hermann Plauson, has published a very elaborate work on this subject, and has investigated the use of kites, balloons and towers, for the utilization of the high potentials existing in the air at different altitudes, and has studied out the construction of motors to be operated by the peculiar type of discharge which will be obtained, if the projects are successfully carried out.

We will first speak of the methods used for collecting electricity from the upper air. The author cites several German patents. One of them shows the use of a kite balloon. The balloon is shown floating in the air, kite fashion, and from it hangs a great net or aerial for the collection of electricity. The conductor from the aerial leads to the ground station; quite an elaborate description is given of the net-work which the patentee proposes to have covered with needle points. A windlass takes in or pays out cable for the balloon, and the patentee claims that by sending the apparatus to a height of about one mile he will have 225,000 volts to draw upon. He then speaks o a battery of 20,000 cells in series, which will use up to 40,000 to 50,000 volts in the charging. This certainly provides for a reasonable large fall of potential.

But our author discards this idea and first suggests something more permanent. He proposes the erection of towers to be in the neighborhood of 1,000 feet high, or about the height of the Eiffel Tower. At the summit he has his collecting aerial. The appliance consists of a number of copper tubes; within each one he proposes to burn gas lamps, whose products of combustion will reach the aerial, a collecting net-work covering the tops of the tubes. One of his apprehensions is that if rain should wet his connections trouble might ensue, so he proposes a protection at the top in the shape of a great bell-like shield, resembling in his terms “a Siamese pagoda”. He also compares the form of the protection to that of a great petticoat insulator. Another of his difficulties is that he must have his tower insulated from the earth. He, therefore describes a complicated foundation for his structure. He proposes first to pour in at the bottom of the excavation a foundation of simple concrete. On this he places a layer of asphalt, and then a layer of cast glass, three to ten feet thick, and then comes a reinforced concrete foundation, to which the metallic foot of the tower is to be anchored. This foundation must rise at least seven feet above the ground level, and is to be boarded in on all sides to protect it from moisture. The author’s idea s to erect a number of these towers connected by a horizontal cable, to which the aerials for collection of potentials are secured.

The author strongly advocates balloons as collectors of the electric power of the air. These he depicts covered with spots. These spots indicate areas to be variously coated and prepared to collect potential from the atmosphere.

In the first place he describes the balloon as made of thin metallic leaf supported by internal ribs. Steel wires silver-plated, copper-plated, or aluminum-coated, run from the balloon to the pendant or junction ring. To this ring the tether cable is attached and runs to an insulated windlass on the surface of the earth. The balloon is to rise to an altitude varying from 300 feet to three miles.

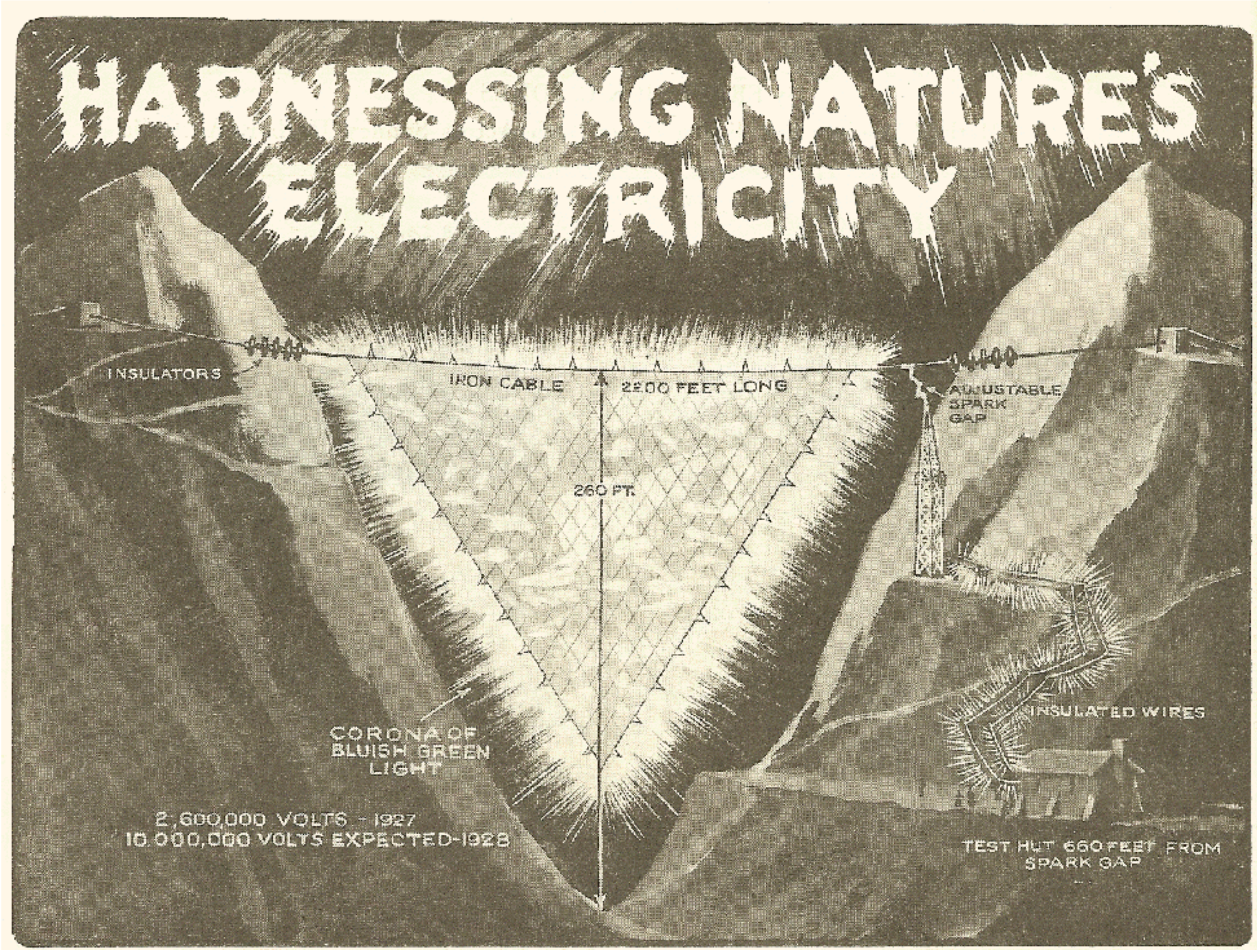
The coating of the spots is to be of the thinnest amalgam, of mercury and gold, or zinc, or even polonium, perhaps only 1/2500 inch thick. All over the upper face of the balloon are numberless metal points. To prepare the needle-like wires, they are collected into bundles and are treated electrolytically in a bath, so as to be dissolved in part. This gives a sharp point and roughened surface, all adapted for collecting the electric energy. The points may be of copper, steel, or some hard metallic alloy. After this corrosion. As it may be termed, the wires are plated with gold or other of the so-called noble metals. It is advised that polonium or radium salts be added to the plating bath.

Dr Plauson devotes many pages of his book to describing his motor. This is a rotary motor including a stator and rotor and its peculiarity is that it contains no coils, develops no electromagnetic field properly speaking, but works by static excitation. One typical arrangement is shown in our illustration. The stator plates and rotor plates are concentric with each other, representing segments of cylinders. The alternation of negative and positive charged plates produces the rotation. In the connections there is included a safety spark gap to take care of dangerous potentials. Inductances and capacities are also used and indicated. It was found that the plates heated, owing to the Foucalt currents, and to overcome this, several methods of subdividing the stator and rotor plates, are described by the author.

The whole subject is quite captivating, and it really seems as if the utilization of the electricity of the air may be almost in sight. It would seem possible to carry out experiments in this direction by means of the Eiffel Tower, but of course, the trouble here is that the tower is grounded, and perfect insulation of the collecting surface is absolutely essential.

And now our author gives us some practical details. He says that on the Finland plains he carried out experiments with a balloon made of aluminum leaf with collecting needles of amalgamated zinc with a radium preparation as an ionizer. The surface of the balloon was sprinkled over with zinc amalgam. It was sent up to a height of 300 meters, early 1,000 feet, and was held by a copper-plated steel wire. A constant current of 1.8 amperes at an average of 400 volts potential difference was obtained. This gave nearly three-quarters of a kilowatt, or close to one horsepower. The collector of the balloon insulated from the earth showed a tension of 42,000 volts. By sending up a second balloon with an antenna to the same height at a distance of 100 meters from the first balloon, a current of over 3 amperes was obtained. Then by putting into the circuit a large condenser, whose capacity was equal to the surface capacity of both balloons, and of the antenna connections, the current rose to 6.8 amperes with about 500 volts mean tension. By the use of these two balloons, he eventually ran up the power to 3.4 kilowatts.

Science & Invention (June 1928)


HARNESSING NATURE'S ELECTRICITY
INSULATORS
IRON CABLE
2200 FEET LONG
ADJUSTABLE SPARK GAP
260 FT.
INSULATED WIRES
CORONA OF BLUISH GREEN LIGHT
2,600,000 VOLTS - 1927
10,000,000 VOLTS EXPECTED-1928
TEST HUT 660 FEET FROM SPARK GAP

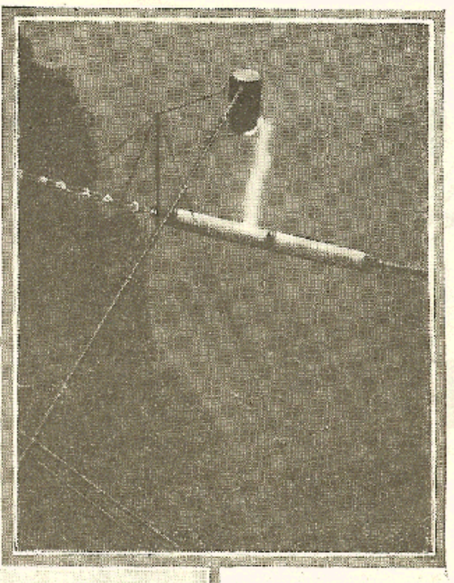
Remarkable European Experiments with Atmospheric Electrical Discharges with Potentials as High as 3,000,000 Volts

By HENRY TOWNSEND

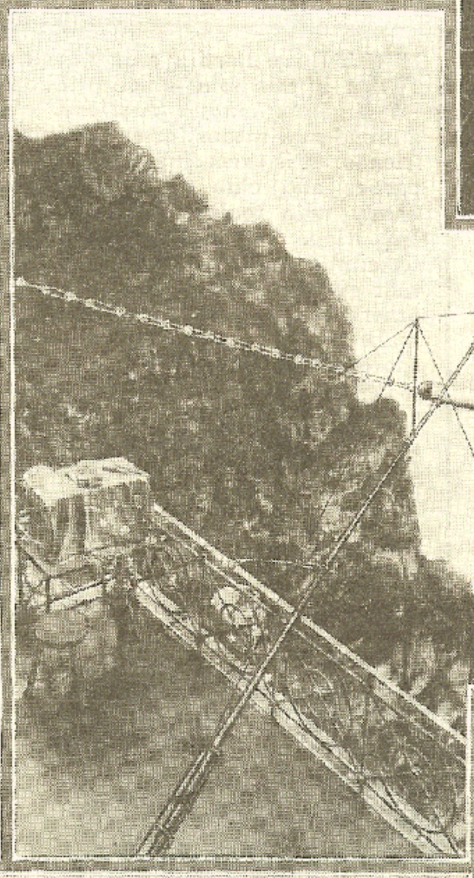
elevation of 350 ft., and these students of natural electrical phenomena have found a very desirable location in the Alps, where they can suspend between one mountain and an adjacent one, a strong iron cable having a length of about 2,000 ft. This cable is about 250 feet above the intervening valley, and from it these daring engineers have suspended a coarsely woven wire net, which serves as an electrical capacity to gather the electricity from the atmosphere. As shown in the pictures, the wire net is supplied with numerous sharp points to aid in collecting the current from the air.

As the accompanying photographs of the actual apparatus and wire cable used last year clearly show, an adjustable spark gap of considerable length is provided. By adjusting this spark gap to various lengths, it is possible to judge the voltage of the discharge which leaps the gap at any moment. Mr. F. W. Peek, Jr., the well-known American worker in the realm of high voltage measurements, together with other engineers, have provided tabulated data and curves for various lengths of both needle and sphere type spark gaps. As one of the accompanying diagrams shows, it is a simple matter to calculate the voltage when a certain length of gap is used. The engineer first checks the length of the gap on the chart; he then follows a line horizontally from the gap length, to where it intersects with the angular line on the chart; and from the point of intersection he looks in a visual line downward to a place where the voltage is given. For needle spark gap measurements, the characteristic curve on the chart is practically a straight line, while for sphere gaps the characteristic curve on the voltage versus gap length, is a curved line. Those interested in high voltage measurements by means of the spark gap method can find the voltage-gap tables and charts in the *Standardization Rules* of the American Institute of Electrical Engineers. According to Mr. Peek's researches, the voltage per foot of atmospheric electrical discharges is about 100,000, while in laboratory measurements with A.C., transformer high potential discharges, the average voltage per foot of spark was found to be about 150,000 volts. The voltage of a lightning flash may

(*Continued on page* 156)

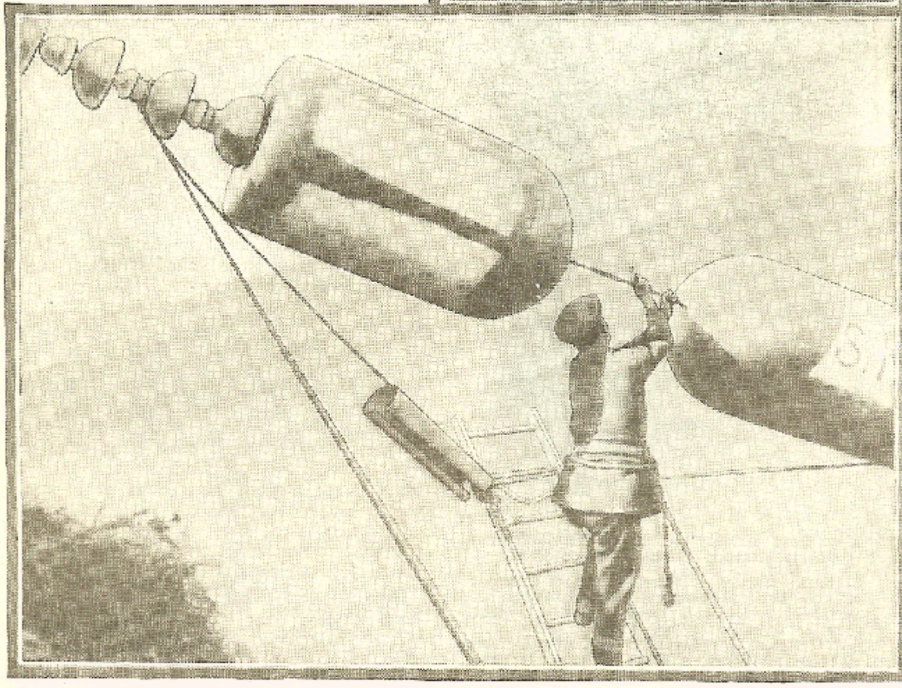


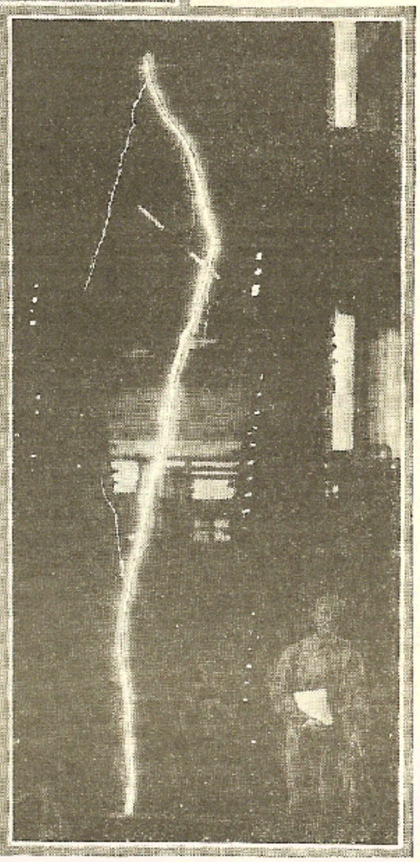
Actual photo above shows 13 ft., heavy spark obtained from the collecting net in the Alps by the German scientists. The voltage is about 2,000,000. The spark occurred once per second for 30 minutes.



Photo, left, shows the adjustable spark gap used in the Alps. Notice the heavy electrode on the end of the adjustable arm to which the spark jumps.

Actual photograph of the experimental "kite" used by the German experimenters in the Alps Mountains, for the purpose of accumulating high potential electrical discharges from the atmosphere. Note the size of the insulators.



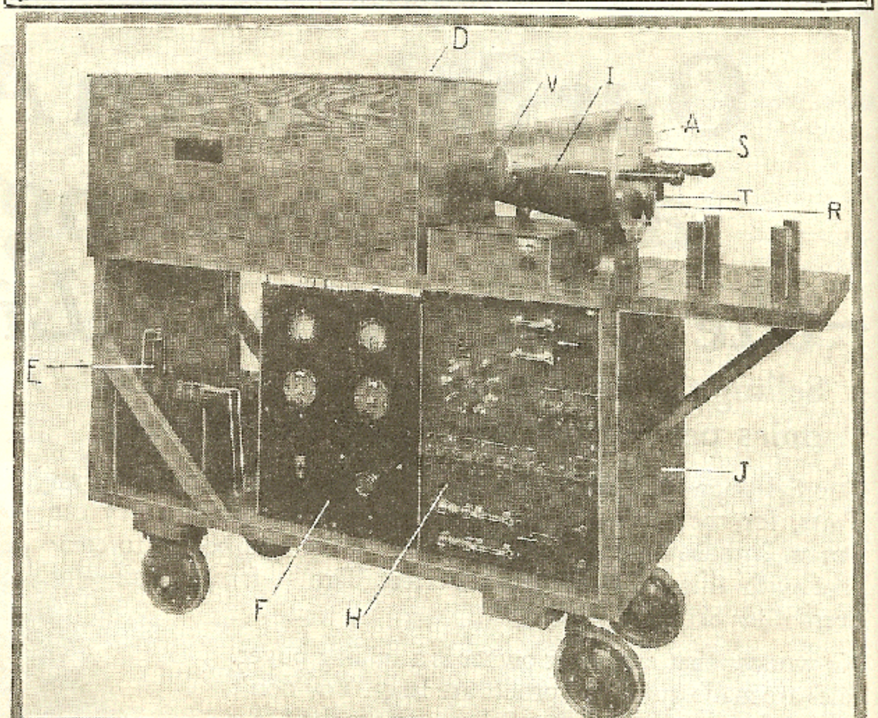


Below we see 3,000,000-volt artificial lightning stroke produced in G. E. Laboratory at Pittsfield, Mass. Note man.

HARNESSING NATURE'S ELECTRICITY

By HENRY TOWNSEND

(*Continued from page* 111)



Remarkable cathode ray oscillograph used by Mr. F. W. Peck, Jr., in causing lightning to write its autograph with a pencil of electrons on a photographic film.

easily be 100,000,000 volts, as Mr. Peek has pointed out in one of his scientific papers.

WHY THE EXPERIMENTS ARE BEING MADE

ONE of the main reasons why these dangerous experiments are being carried on by the three young German scientists, whose names we have already learned, is because science believes that with a sufficiently high voltage, it will be possible for man to disintegrate the atom, and in this way make available a tremendous source of power as yet untapped. These experts have calculated that they will be able to obtain electrical energy in sufficient quantity from one of these powerful atmospheric discharges to equal the Alpha rays obtained from 220 pounds of radium. As we have mentioned before, these experiments are of course fraught with great danger, and for that reason the experimenters seek refuge in a special lightning-proof hut, which is located about 600 ft., from the spark gap. When electrical storms are in the vicinity, it is especially important that the scientists keep within their protected fortress, for otherwise they would very probably be killed by a stray electrical discharge.

One of the peculiar things about this whole line of experiment is that the average layman does not realize perhaps, that there is a high electrical stress in the atmosphere on clear days, as well as when thunder storms are overhead. This fact has been known for a hundred years and more, and many years ago measurements of the various electrical potentials at increasing altitudes, were observed and measured by scientific investigators. There are a number of different ways in which these high electrical potentials found in the atmosphere can be measured; one of these methods involves the use of a calibrated spark gap. In this case the gap is set to a predetermined length, and when a discharge jumps this gap, the engineers know of course from previous experience and measurements, just what voltage is present. Another method of measuring extra high potentials, such as here encountered, requires the use of a static voltmeter, which involves the use of a stationary and of a movable or rotary set of metal plates, forming a condenser, to which an indicating needle is attached. For voltages above 2,000, static voltmeters have been used in a great many American central stations, and they have many desirable and useful characteristics. Of course as the voltage to be measured increases, the space between the quadrant shaped stationary and movable plates is increased and vice versa. The electrostatic field from voltages below 2,000 is not sufficient to warrant the use of a static voltmeter. Another method of measuring high potentials involves the use of the so-called vacuum tube voltmeter.

The general characteristics of the atmospheric electrical discharges, including lightning, have been measured and recorded by one of the newest scientific instruments, known as the cathode ray oscillograph. By means of this quite remarkable, high voltage scientific apparatus, Mr. Peek, one of the well-known General Electric Company staff of research engineers, has made some very interesting and remarkable discoveries concerning the nature of natural electrical discharges, particularly of lightning discharges. Many people will probably wonder why Mr. Peek and some of his colleagues in the engineering profession, including the three daring German students, Messrs. Brasch, Lange and Urban, play with such dangerous electrical discharges, and why they are at all interested in them. We explained previously why the German savants are intent on finding out all they can about these tremendous voltages obtained from the atmosphere, while Mr. Peek, we may say, also has a very practical reason for carrying on experiments with these death-dealing bolts of Thor. Mr. Peek has been for many years intent on finding out what causes the huge insulators on long distance, high potential transmission lines to break down when electrical storms break loose over these regions.

Plauson's Electrical Patents

USP # 1,540,998
Conversion of Atmospheric Electric Energy
6-09-1925

GB157262
Improvements in Electric Motors
1922-07-10

GB157263
Process and Apparatus for Converting Static Atmospheric Electrical Energy into Dynamic Electrical Energy of any Suitable High Periodicity
7-10-1922

British Patent # 299,735
Apparatus for Producing Rapidly Moving Electrons
7-15-1930

FI21227
Elektrisk uppvärmningsanordning
4-25-1946

Varmelegeme med elektriske varmemodstande
DK67691C
9-27-1948

FR877362
Dispositif de chauffage électrique
12-04-1942

DE734794
Elektrisches Heizsystem
4-24-1943

CH222509
Elektrischer Heizkörper zur Erwärmung von Flüssigkeiten
7-31-1942

DE738107
Elektrolyt fuer unmittelbare elektrische Warmwasser-Radiatorenheizung mit Elektroden
8-03-1943

DE433476
Verfahren zur Herstellung von Elektroden und Schleifkontakten fuer Dynamomaschinen
8-31-1926

CH94021
Elektrode und Verfahren zu deren Herstellung
4-01-1922

CA226423
Electrode for Electrolytic Apparatuses
11-21-1922

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http://www.meridian-int-res.com/Energy/Atmospheric.htm

Atmospheric Electricity Research
[Excerpts]

In the nineteenth and early twentieth centuries, a large number of researchers investigated ways to extract electrical power from the Earth's ambient electric field.

The leader in this field was Dr Hermann Plauson who in the 1920s succeeded in generating significant quantities of electrical power comparable with modern solar photovoltaic systems of a similar scale...

The leader in this field before the Second World War appears to have been Dr Hermann Plauson. Dr Plauson was an Estonian citizen who lived in Hamburg and Switzerland. He carried out experiments in Finland with aerostats manufactured from magnesium-aluminium alloy, covered with electrolytically deposited needles. The needles were further doped with a radium compound to increase local ionisation of the air. (This was the era in which the hands of watches were hand painted with radium to make them luminous in the dark). Zinc amalgam patches were also painted onto the aerostats. Plauson obtained a power output of between 0.72kW and 3.4kW from one and two aerostats 300m above ground level. Dr Plauson filed patents in the USA, Great Britain and Germany in the 1920s. His book "Gewinnung und Verwertung der Atmosphärischen Elektrizität" is the most detailed known account of the technology.

Other atmospheric electricity researchers contemporary to Dr Plauson included Walter Pennock and MW Dewey in the USA, Andor Palencsar in Hungary and Dr Heinrich Rudolph in Germany. Hippolyte Charles Vion in Paris predated them all, putting forward proposals in the 1850s and 1860s.

Heinrich Rudolph made an interesting contribution to the design of the aerostat collectors. In 1898 he designed an elliptical aerostat made up of faceted surfaces to minimise the effect of wind. The design bears a strong resemblance to Northrop's 2003 UCARS unamnned helicopter UAV project. The design uses the Coanda Effect to help keep the aerostat on station and minimise wind effects.

In recent times, the only person who seems to have been active in this field is Dr Oleg Jefimenko. Dr Jefimenko carried out experiments on driving electrostatic motors from the Earth's electric field in the 1970s and has recently called for research into the neglected field of electrostatic motors to be renewed.

MIR's Research Programme

Since 1997 we have been carrying out theoretical research into conversion of atmospheric electricity into useable electrical power.

From a low level (5m high) simple zinc antenna we are able to obtain sufficient charge to light a number of white power LEDs. Further experimental investigations with metallic aerostat collectors and cavity resonant slow wave antennae concepts are ongoing...

Advantages of Atmospheric Electricity

Simple and robust technology
Low Cost technology - much cheaper than photovoltaics or wind turbines
Available day and night in all weather conditions - in fact, more power is produced at night than during the day
Available at any point on the Earth's surface

1. *Gewinnung und Verwertung der Atmosphärischen Elektrizität*, Dr Hermann Plauson, Hamburg, (1920)
2. Conversion of Atmospheric Electric Energy, USP 1,540,998, Dr Hermann Plauson, (1925)
3. Assembly for the Induction of Lightning into a Superconducting Magnetic Energy Storage System, USP 5,367,245 Goven Mims, (1994)
4. Electrostatic Motors are Powered by Electric Field of the Earth; CL Stong, *Scientific American*, (October 1974)
5. Operation of Electric Motors from the Atmospheric Electric Field; Dr Oleg Jefimenko, *American Journal of Physics*, vol. 39, July 1971.
6. *Electrostatic Motors: Their Principles, Types and Theory of Operation*; Dr Oleg Jefimenko, Electret Scientific, (1972).
7. Parametric Electric Machine, USP 4,622,510, Ferdinand Cap, (1986).

US Patent # 1,540,998

Conversion of Atmospheric Electric Energy

(9 June 1925)

Hermann PLAUSON

Be it known that I, Hermann Plauson, Estonian subject, residing in Hamburg, Germany, have invented certain new and useful improvements in the Conversion of Atmospheric Electric Energy, of which the following is a specification.

Methods of obtaining atmospheric electricity by means of metallic nettings set with spikes which are held by means of ordinary or anchored kite balloons made of fabric and filled with hydrogen, are in theory already known. Atmospheric electricity obtained in this way has been suggested to be used in the form of direct current for the charging of accumulators. This knowledge however is at present only theoretical as the conversion in practice has hitherto been a failure. No means are known of protecting the apparatus from destruction by lightning. The balloons used for collecting the charge must also me be made of very large size in order to be able to support the weight of the metallic netting and the heavy cable connections.

Instead of using heavy metallic netting as collectors attached to single air ballons of non-conducting materials which are liable to be torn and are permeable to the gas, it is proposed to use metallic balloon collectors which have the following important advantages ---

(a) The metallic cases are impenetrable to helium and hydrogen; they also represent large metallic weather-proof collecting surfaces.

(b) Radio active means the like may be easily applied internally or externally; whereby the ionization is considerable increased and therewith also the quantity of atmospheric electricity capable of being collected.

(c) Such balloon collectors of light metal do not require to be of large size as they have to carry only their own moderate weight, and that of the conducting cable or wire.

(d) The entire system therefore offers little surface for the action of storm and wind and is resistant and stable.

(e) Each balloon can be easily raised and lowered by means of a winch so that all repairs, recharging and the like can be carried out without danger during the operation.

It is further proposed to use a collecting aerial network of several separate collectors spread out in the air above the earth, which collectors are interconnected by electrical conductors.

According to this invention charges of atmospheric electricity are not directly converted into mechanical energy, and this forms the main difference from previous inventions, but the static electricity which runs to earth through aerial conductors in the form of direct current of very high voltage and low current strength is converted into electro-dynamic energy in the form of high frequency vibrations. Many advantages are thereby obtained and all disadvantages avoided.

The very high voltage of static electricity of a low current strength can be converted by this invention to voltages more suitable for technical purposes and of greater strength. By the use of closed oscillatory circuits it is possible to obtain electromagnetic waves of various amplitude and thereby to increase the degree of resonance of such current. Such resonance allows various values of inductance to be chosen whereby again the governing of the starting and stopping of machines driven thereby by simply tuning the resonance between coils of the machine and the transformer circuit forming the resonance can easily be obtained. Further, such currents have the property of being directly available for various uses, even without employing them for driving motors, of which there may be particularly mentioned, lighting, production of heat and use in electro-chemistry.

Further, with such currents a series of apparatus may be fed without direct current supply through conductors and also the electro-magnetic high frequency currents may be converted by means of special motors adapted for electro-magnetic oscillations into mechanical energy, or finally converted by special machines into alternating current of low frequency or even into direct current of high potential.

The invention is more particularly described with reference to the accompanying diagrams in which: ---

Figure 1 is and explanatory figure.

Figure 2 is a diagrammatic view of the simplest form.

Figure 3 shows a method of converting atmospheric electrical energy for use with motors.

Figure 4 is a diagram showing the use of protective means.

Figure 5 is a diagram of an arrangement for converting large current strengths.

Figure 6 is a diagram of an arrangement including controlling means.

Figure 7 shows means whereby the spark gap length can be adjusted.

Figure 8 shows a unipolar connection for the motor.

Figure 9 shows a weak coupled system suitable for use with small power motors.

Figures 10, 11, and 12 show modified arrangements.

Figure 13 shows a form of inductive coupling for the motor circuit.

Figure 14 is a modified form of Figure 13 with inductive coupling.

Figure 15 is an arrangement with non-inductive motor.

Figure 16 is an arrangement with coupling by condenser.

Figure 17, 18, and 19 are diagrams of further modifications.

Figure 20 shows a simple form in which the serial network is combined with special collectors.

Figure 21 shows diagrammatically an arrangement suitable for collecting large quantities of energy.

Figure 22 is a modified arrangement having two rings of collectors.

Figure 23 shows the connection for three rings of collectors.

Figure 24 shows a collecting balloon and diagram of its connection of condenser batteries.

Figure 25 and 26 show modified collector balloon arrangements.

Figure 27 shows a second method of connecting conductor for the balloon aerials.

Figure 28 shows an auto-transformer method of connection.

Figure 29 shows the simplest form of construction with incandescent cathode.

Figure 30 shows a form with cigar shaped balloon.

Figure 31 is a modified arrangement.

Figure 32 shows a form with cathode and electrode enclosed in a vacuum chamber.

Figure 33 is a modified form of Figure 32.

Figure 34 shows an arc light collector.

Figure 35 shows such an arrangement for alternating current.

Figure 36 shows an incandescent collector with Nernst lamp.

Figure 37 shows a form with a gas flame.

Fig. 1.

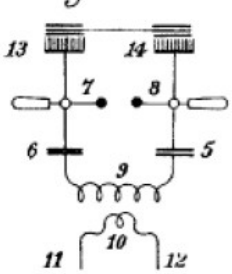


Fig. 2.

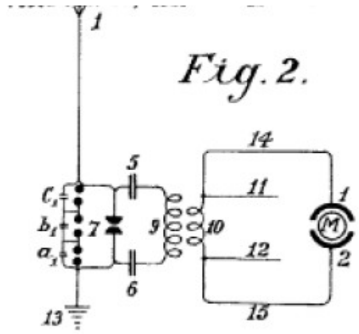


Figure 1 illustrates a simple diagram for converting static electricity into dynamic power of a high number of oscillations. For the sake of clearness in the drawings an influence machine is assumed to be employed and not an aerial antenna. 13 and 14 are combs for collecting the static electricity of the influence machine. 7 and 8 are spark discharging electrodes. 5 and 6 are condensers, 9 an inductive primary coil, 10 secondary coil, 11 and 12 ends of conductors of the secondary coil 10. When the disc of the static influence machine is rotated by mechanical means, the combs collect the electric charges one the positive and the other the negative, and charge the condensers 5 and 6 until such a high potential is formed across the spark gap 7-8, that the spark gap is jumped. As the spark gap 7-8 forms a closed circuit with condensers 5 and 6, and inductive resistance 9, as is well known, waves of high frequency electromagnetic oscillations will pass in this circuit.

The high frequency of the oscillations produced in the primary circuit induces waves of the same periodicity in the secondary circuit. Thus in the primary circuit electromagnetic oscillations are formed by the passage of the spark over the spark gap and these waves are maintained by fresh charges of static electricity.

By suitably selecting the ratio between the number of the coils in the primary and secondary circuits with regard to a correct application of the co-efficients of resonance (especially, inductance and resistance) the high voltage of the primary circuit may be suitably converted into low voltage and high current strength.

When the oscillatory discharges in the primary circuit becomes weaker or entirely cease, the condensers are charged again by the static electricity until the accumulated charge again breaks down the spark gap. All this is repeated as long as electricity is produced by the static machine employing mechanical energy.

An elementary form of the invention is shown in Figure 2 in which two spark gaps in parallel are used one of which may be termed the working gap 7 in Figure 2, whilst the second serves as a safety device for excess voltage and consists of a larger number of spark gaps than the working section, which gaps are arranged in series and are bridged by very small capacities as is illustrated in a, b, c, Figure 2 which allow of uniform sparking in the safety section.

In Figure 2 A is the aerial antenna for collecting charges of atmospheric electricity. 13 is the earth connection of the second part of the spark gap, 5 and 6 are condensers, 9 a primary coil. Now when through the aerial A the positive atmospheric electricity seeks to combine with the negative charge to earth, this is prevented by (the air gap between) the spark gaps. The resistance of the spark gap 7 is, as shown in the drawings, lower than that of the other safety section which consists of three spark gaps connected in series, and consequently a three times greater air resistance is offered by the latter.

So long, therefore, as the resistance of the spark gap 7 is not overloaded, so that the other spark gaps have an equal resistance with it the discharges take place only over spark gap 7. Should however the voltage be increased by and influences so that it might be dangerous for charging the condensers 5 and 6 or for the coil insulation 9 and 10 in consequence of break down, by a correct regulation of this spark gap the second spark gap can discharge free from inductive effects direct to earth without endangering the machine.

Without this second spark gap, arranged in parallel having a higher resistance than the working spark gap it is impossible to collect and render available large quantities of electrical energy.

The actions of this closed oscillation circuit consisting of spark gap 7, two condensers 5 and 6, primary coil 9, and also secondary coil 10 is exactly the same as the one described in Figure 1 with the arrangement of the static induction machine with the only difference that here the second spark gap is provided. The electromagnetic high frequency alternating current obtained can be tapped off from the conductors 11 and 12 for lighting and heating purposes. Special kinds of motors adapted for working with these peculiar electrical charges may be connected at 14 and 15 which can work with static electricity charges or with high frequency oscillations.

In addition to the use of spark gaps in parallel a second measure of security is also necessary for taking off the current. This precaution consists according to this invention, in the introduction of and method of connecting certain protective electromagnets or choking coils in the aerial circuit as shown by S in Figure 3.

A single electromagnet only having a core of the thinnest possible separate laminations is connected with the aerial.

In the case of high voltages in the aerial network or at places where there are frequent thunder storms, several such magnets may however be connected in series.

In the case of large units or plants several electromagnets can be employed in parallel or in series parallel.

The windings of these electromagnets may be simply connected in series with the aerials. In this case the winding preferably consists of several thin parallel wires, which make up together, the necessary section.

The winding may be made of primary and secondary windings in the form of a transformer. The primary windings will be then connected in series with the aerial network, and the secondary winding more or less short-circuited over a regulating resistance or an induction coil. In the latter case it is possible to regulate to a certain extent the effect of the choking coils. In the further description of the connecting and constructional diagrams the aerial electromagnet choke coil is indicated by a simple ring S.

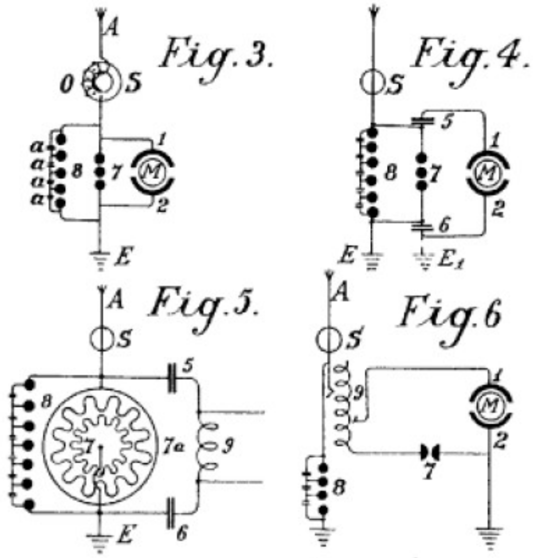


Figure 3 shows the simplest way of converting atmospheric electricity into electromagnetic wave energy by the use of special motors adapted for high oscillatory currents or static charges of electrical energy. Recent improvements in motors for working with static charges and motors working by resonance, that is to say, having groups of tuned electromagnetic cooperating circuits render this possible but such do not form part of the present invention.

A motor adapted to operate with static charges will for the sake of simplicity be diagrammatically indicated by the two semicircles 1 and 2 and the rotor of the motor by a ring M (Figure 3). A is a vertical aerial or aerial network. S the safety choke or electromagnet with coil O as may be seen is connected with the aerial A. Adjacent the electromagnet S the aerial conductor is divided into three circuits, the circuit 8 giving the safety spark gap, the circuit 7 with the working spark gap, and then a circuit including the stator terminal 1, the rotor and stator terminal 2 at which a connection is made to the earth wire. The two spark gaps are also connected metallically with the earth wire. The method of working these diagrams is as follows:

The positive atmospheric electric charge collected tends to combine with the negative electricity (or earth electricity) connected with the earth wire. It travels along the aerial A through the electromagnet S without begin checked as it flows in the same direction as the direct current. Further, its progress is arrested by two sparks gaps placed in the way and the stator condenser surfaces. The stator condenser surfaces are charged until the charge is greater than the resistance of the spark gap 7, whereupon a spark springs over the spark gap 7 and an oscillatory charge is obtained as by means of the motor M, stator surfaces 1 and 2, and spark gap 7, a closed oscillation circuit is obtained for producing the electromagnetic oscillations. The motor here forms the capacity and the necessary inductance and resistance, which, as is well known, are necessary for converting static electricity into electromagnetic wave energy.

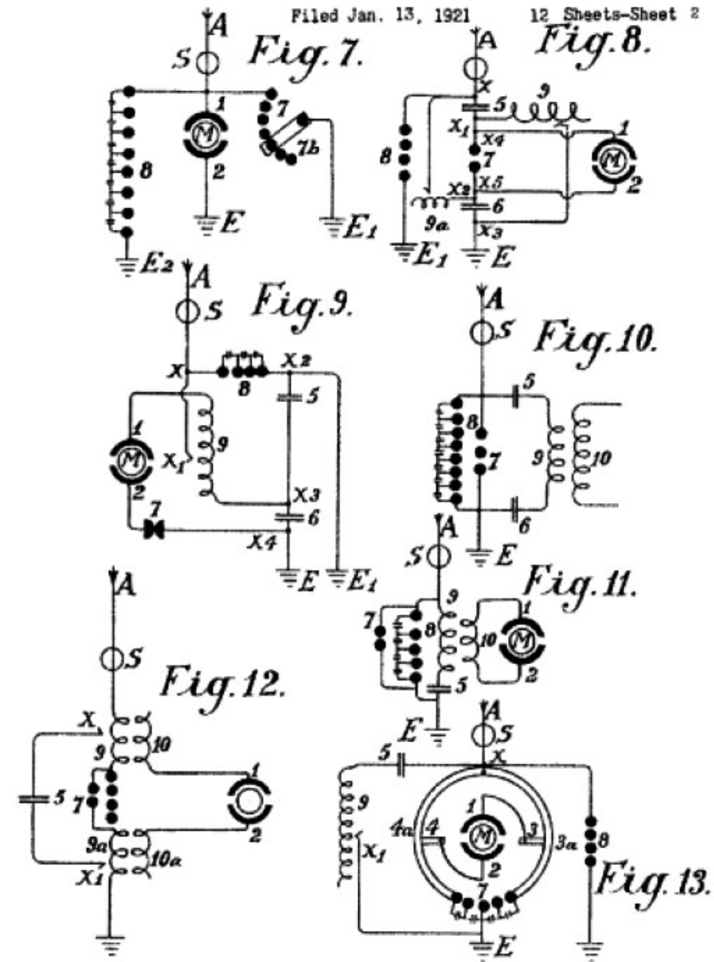
The discharge formed are converted into mechanical energy in special motors and cannot reach the aerial network by reason of the electromagnet or choke. If, however, when a spark springs over the spark gap 7 a greater quantity of atmospheric electricity tends to flow to earth, a counter voltage is induced in the electromagnet, which is greater the more rapidly and strongly the flow of current direct to the earth is. By the formation of this opposing voltage a sufficiently high resistance is offered to the flow of atmospheric electricity direct to earth to prevent a short circuit with the earth.

The circuit containing spark gap 8 having a different wave length which is not in resonance with the natural frequency of the motor, does not endanger the motor and serves as security against excess voltage, which, as practical experiments have shown, may still arise in certain cases, but can be conducted direct to earth through this spark gap.

In the diagram illustrated in Figure 4 the spark gap 7 is shunted across condensers 5 and 6 from the motor M. This construction affords mainly a better insulation of the motor against excess voltage and a uniform excitation through the spark gap 7.

In Figure 5 a diagram is illustrated for transforming large current strengths which may be employed direct without motors, for example, for lighting or heating purposes. The main difference is that here the spark gap consists of as star shaped disk 7 which can rotate on its own axis and is rotated by a motor opposite similarly fitted electrodes 7a. When separate points of stars face one another, discharges take place, thus forming an oscillation circuit over condensers 5 and 6, and inductance 9 for oscillatory discharges. It is evident that a motor may also be directly connected to the ends of the spiral 9.

The construction of the diagram shown in Figure 6 permits of the oscillation circuit of the motor being connected with an induction coil/ Here a regulating inductive resistance is introduced for counter-acting excess voltages in the motor. By cutting the separate coils 9 (coupled inductively to the aerial) in or out the inductive action on the motor may be more or less increased or variable aerial action may be exerted on the oscillation circuit.



In Figure 7 the oscillation circuit is closed through the earth (E and E1). The spark gap 7 may be prolonged or shortened by more or fewer spark gaps being successively connected by means of a contact arm 7b.

Diagram 8 shows a unipolar connection of the motor with the aerial network. Here two oscillation circuits are closed through the same motor. The first oscillation circuit passes from aerial A through electromagnet S, point *x*, inductance 9a to the earth condenser 6 and further, over spark gap 7 to the aerial condenser 5 and back to *x*. The second oscillation circuit starts from the aerial condenser 5 at the point x^1 over the inductance 9 to the earth condenser 6 at the point x^3 and through the condenser 6 over the spark gap 7 back to x^1. The motor itself is inserted between the two points of the spark gap 7. From this arrangement slightly damped oscillation wave currents are produced.

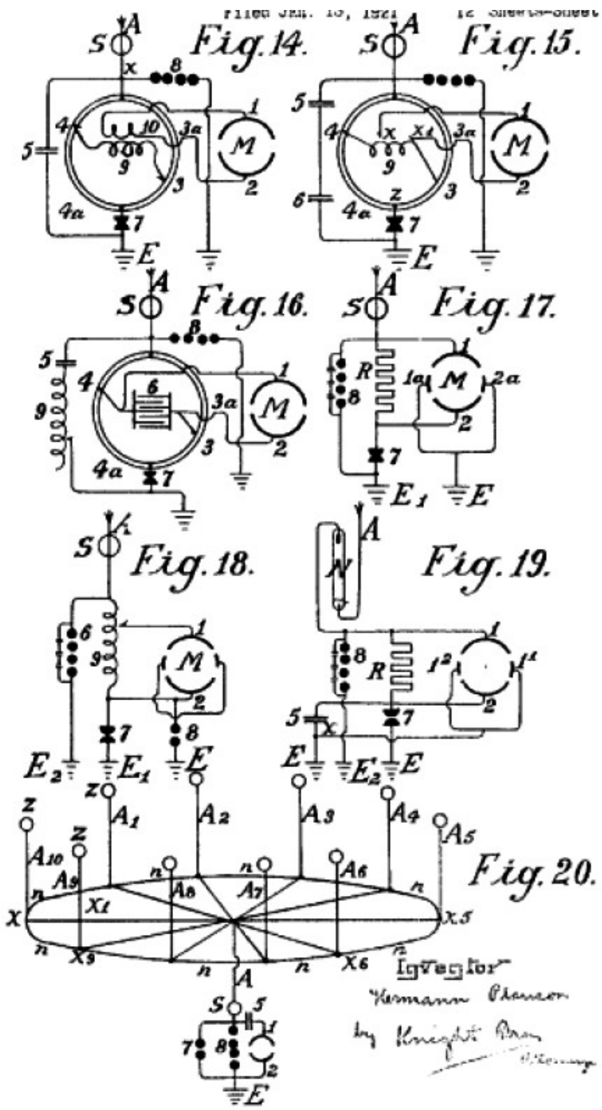
In the diagram illustrated in Figure 9 a loosely coupled system of connections is illustrated which is assumed to be for small motors for measuring purposes. A indicates the aerial conductor, S the electromagnet in the aerial conductor, 9 the inductance, 7 the spark gap, 5 and 6 condensers, E the earth, M the motor, and 1 and 2 stator connections of the motor. The motor is directly metallically connected with the oscillation circuit.

In Figure 10 a purely inductive coupling is employed for the motor circuit. The motor is connected with the secondary wire 10 as may be seen in Figure 11 in a somewhat modified diagram connection. The same applies to the diagram of Figure 12.

The diagrams hitherto described preferably allow of motors of small and medium strength to be operated. For large aggregates, however, they are too inconvenient as the construction of two or more oscillation circuits for large amounts of energy is difficult; the governing is still more difficult and the danger in switching on or off is greater.

A means of overcoming such difficulties is shown in Figure 13. The oscillation circuit here runs starting from the point x over condenser 5, variable inductance 9, spark gap 7, and the two segments (3a and 4a) forming arms of a Wheatstone bridge, back to x, If the motor is connected by brushes 3 and 4 transversely to the two arms of the bridge as shown in the drawings, electromagnetic oscillations of equal sign are induced in the stator surfaces 1 and 2 and the motor does not revolve. If however the brushes 3 and 4 are moved in common with the conducting wires 1 and 2 which connect the brushes with the stator poles a certain alteration or displacement of the polarity is obtained and the motor commences to revolve.

The maximum action will result if one brush 3 comes on the central sparking contact 7 and the other brush 4 on the part *x*. They are however, usually in practice not brought on the central contact 7 but only held in the path of the bridge segments 4a and 3a in order not to connect the spark gaps with the motor oscillation circuit.



As however, the entire oscillation energy can thereby not act on the motor it is better to carry out the same system according to the diagram 14. The diagram 14 differs from the foregoing only by the motor not being directly metallically connected with the segments of the commutator, but only a primary coil 9 which induces in a secondary coil 10, current which feeds the motor M and takes the place of the rotor. By this arrangement a good transforming action is obtained, a loose coupling and also an oscillation circuit without a spark gap.

In Figure 15 the motor is not purely inductive as in 14, but directly metallically branched off from the primary coil (at x and x^1) after the principle of the auto-transformer.

In Figure 16 instead of an inductance a condenser 6 is in similar manner, and for the same object inserted between the segments 3a and 4a. This has the advantage that the segments 3a and 4a need not be made of solid metal but may consist of spiral coils whereby a more exact regulation is possible and further motors of high inductance may be employed.

The arrangements of Figures 17, 18 and 19 may be employed for use with resonance and particularly with induction condenser motors; between the large stator induction condenser surfaces, small reversing pole condenser surfaces, mall reversing pole condensers are connected, which, as may be seen from Figures 17, 18 and 19 are led together to earth. Such reversing poles have the advantage that with large quantities of electrical energy the spark formation between the separate oscillation circuits ceases.

Figure 19 shows a further method which prevents electromagnetic oscillations of high number of alternations formed in the oscillation circuit striking back to the aerial conductor. It is based on the well known principle that a mercury lamp, one electrode of which is formed of mercury, the other of solid metal such as steel allows an electric charge to pass in only one direction from the mercury to the steel and not vice versa. The mercury electrode of the vacuum tube N is therefore connected with the aerial conductor and the steel electrode with the oscillation circuit. From this it results that charges can pass only from the aerial through the vacuum tube to the oscillation circuit, but not vice versa. Oscillations which are formed on being transformed in the oscillation circuit cannot pass to the aerial conductor.

In practice these vacuum tubes must be connected behind an electromagnet as the latter alone affords no protection against the danger of lightning.

As regards the use of spark gaps, all arrangements as used for wireless telegraphy may be used. Of course the spark gaps in large machines must have a sufficiently large surface. In very large stations they are cooled in liquid carbonic acid or better still in liquid nitrogen or hydrogen; in most cases the cooling may also take place by means of liquefied low homologues of the metal series or by means of hydrocarbons the freezing point of which lies at between –90° C and –40° C. The spark gap casing must also be insulated and be of sufficient strength to be able to resist any pressure which may arise. Any undesirable excess super-pressure which may be formed must be automatically let off. I have employed wit very good results mercury electrodes which were frozen in liquid carbonic acid, the cooling being maintained during the operation from the outside through the walls.

Figure 20 is one of the simplest forms of construction of an aerial network in combination with collectors, transformers and the like illustrated diagrammatically. E is here the earth wire, 8 the safety spark gap, 7 the working spark gap, 1 and 2 the stator surfaces of the motor, 5 a condenser battery, S the protective magnet which is connected with the coil in aerial conductor, A^1 to A^{10} aerial antennae with collecting balloons, N horizontal collecting or connecting wire from which, to the center a number of connections run.

The actual collectors consist of metal sheaths preferably made of an aluminum magnesium alloy, and are filled with hydrogen or helium and are attached t copper plated steel wires. The size of the balloon is selected so that the actual weight of the balloon and the weight of the conducting wire is supported thereby. On top of the balloon aluminum spikes, made and gilded in a special manner hereinafter described, are arranged in order to produce a conductor action. Small quantities of radium preparations, more particularly polonium-ionium or meso-thorium preparations considerably increase the ionization, and therewith the action of these collectors.

In addition to metal balloons, fabric balloons which are superficially metal coated according to Schoop’s metal spraying process, may also be employed. A metallic surface may also me produced by lacquering with metallic bronzes, preferably according to Schoop’s spraying process or lacquering with metallic bronze powders in two electrical series of widely different metals, because thereby the collecting effect is considerably increased.

Instead of the ordinary round balloons, elongated cigar shaped ones may be employed. In order also to utilize the frictional energy of the wind, patches or strips of non-conducting substances which produce electricity by friction, may be attached to the metalized balloon surfaces. The wind will impart a portion of its energy in the form of frictional electricity, to the balloon casing, and thereby the collecting effect is substantially increased.

In practice however, very high towers (up to 300 meters is fully admissible) may be employed as antennae. In these towers copper tubes rise freely further above the top of the tower. A gas lamp secured against the wind is then lit at the point of the copper tube and a netting is secured to the copper tube over the flame of this lamp to form a collector. The gas is conveyed through the interior of the tube up to the summit. The copper tube must be absolutely protected from moisture at the place at which it enters the tower and also rain must be prevented running down the walls of the tower which might lead to a bad catastrophe. This is done by bell shaped enlargements which expand downwards, being arranged in the tower in the form of high voltage insulators of Siamese pagodas.

Special attention must be devoted to the foundations of such towers. They must be well insulated from the ground, which may be obtained by first embedding a layer of concrete in a box form to a sufficient depth in the ground and inserting in this an asphalt lining and then glass bricks cast about 1 or 2 meters in thickness. Over this in turn there is a ferro-concrete layer in which alone the metal foot of the tube is secured. This concrete block must be at least 2 meters from the ground and be fully protected at the sides by a wooden covering, from moisture. In the lower part of the tower a wood or glass house for the large condenser batteries or for the motors may be constructed. In order to lead the earth connection to the ground water, a well insulated pit constructed of vitreous brick, must be provided. Several such towers are erected at equal distances apart and connected with a horizontal conductor. The horizontal connecting wires may either run directly from tower to tower or be carried on bell shaped insulators similar to those in use for high voltage conductors. The width of the network may be of any suitable size and the connection of the motors can take place at any suitable places.

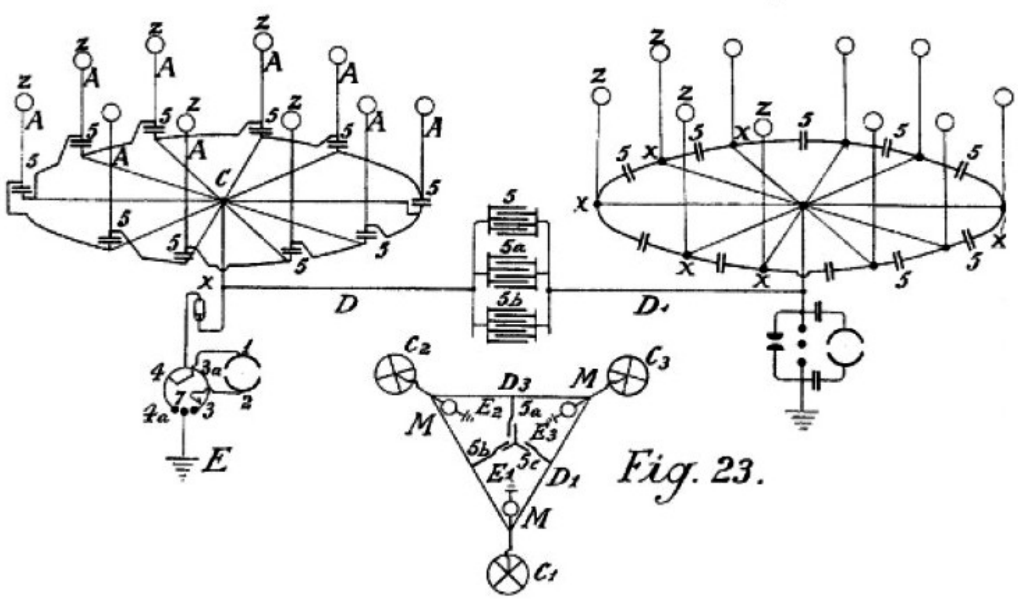


Fig. 21. Fig. 22. Fig. 23.

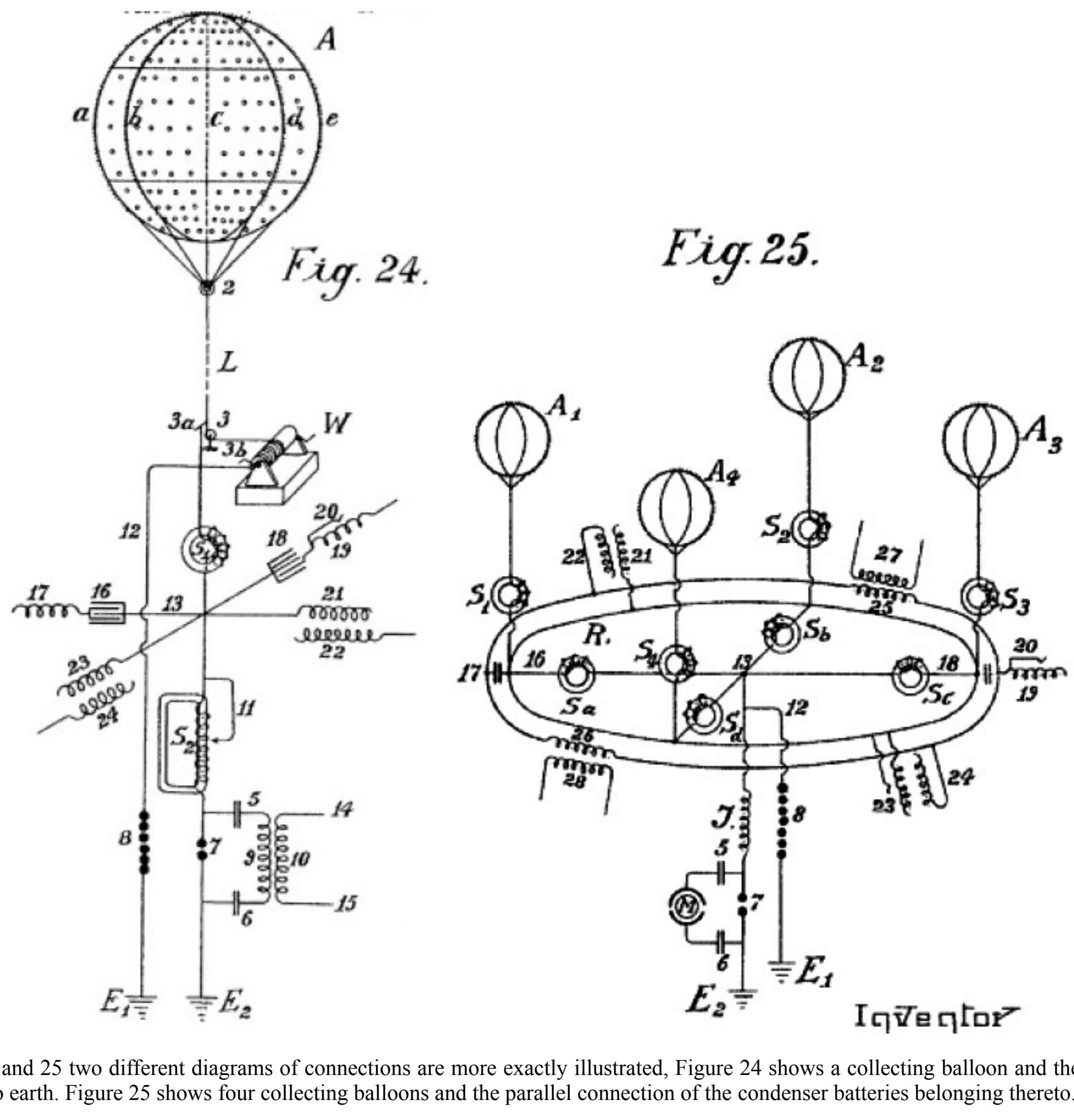
In order to collect large quantities of electricity with few aerials it is well to provide the aerial conductor with batteries of condensers as shown in Figures 21 and 22. In Figure 21 the batteries of condensers 5 are connected on the one hand with the aerial electricity collectors Z by the aerial conductor A, and on the other hand interconnected in series with an annular conductor from which horizontal conductors run to the connecting points C to which the earth wire is connected.

Figure 22 shows a similar arrangement, Should two such series of antennae rings be shown by a voltmeter to have a large difference of potential (for example, one in the mountains and one in the plain) or even of different polarity these differences may be compensated for by connecting sufficiently large condenser batteries (5, 5a, 5b) by means of Maji star conductors D and D^1. In Figure 23 a connection of three such rings of collectors to form a triangle with a central condenser battery is illustrated.

The condenser batteries of such large installations must be embedded in liquid gases or in liquids freezing at very low temperatures. In such cases a portion of the atmospheric energy must be employed for liquefying these gases. It is also preferable to employ pressure. By this means the condenser surfaces may be diminished, and still allow for large quantities of energy to be stored, secure against breakdown. For smaller installation the immersing of the condensers in well-insulated oil or the like, suffices. Solid substances on the other hand cannot be employed as insulators.

The arrangement in the diagrams hitherto described was always such that the condenser batteries were connected with both poles directly to the aerial condensers. An improved diagram of the connections for obtaining atmospheric electricity for the condenser batteries has however, been found to be very advantageous. This arrangement consists in that they are connected only by one pole (unipolar) to the collecting network. Such a method of arrangement is very important, as by means of it a constant current and an increase of the normal working pressure or voltage is obtained. If for example a collecting balloon aerial which is allowed to rise to a height of 300 meters, shows 40,000 volts above earth voltage, in practice it has been found that the working voltage (with a withdrawal of the power according to the method hereinbefore described by means of oscillating spark gaps and the like) is only about 400 volts. If however, the capacity of the condenser surfaces be increased, which capacity in the above mentioned case was equal to that of the collecting surface of the balloon aerials, to double the amount, by connecting the condenser batteries with only one pole, the voltage rises under an equal withdrawal of current up to and beyond 500 volts. This can only be ascribed to the favorable action of the connecting method.

In addition to this substantial improvement it has also been found preferable to insert double inductances with electromagnets and to place the capacities preferably between two such electromagnets. It has also been found that the useful action of such condensers can be further increased if an induction coil be connected as inductive resistance to the unconnected pole of the condenser, or still better if the condenser itself be made as an induction condenser. Such a condenser may be compared with a spring which when compressed carries in itself accumulated force, which it again gives off when released. In charging, a charge with reversed sign is formed at the other free condenser pole, and if through the spark gap a short circuit results, the accumulated energy is again given back since now new quantities of energy are induced at the condenser pole connected with the conductor network, which in fact charges with opposite signs to that at the free condenser pole. The new induced charges have of course the same sign as the collector network. The whole voltage energy in the aerial is thereby however increased. In the same space of time larger quantities of energy are accumulated than is the case without such inserted condenser batteries.



In Figures 24 and 25 two different diagrams of connections are more exactly illustrated, Figure 24 shows a collecting balloon and the diagram of the connections to earth. Figure 25 shows four collecting balloons and the parallel connection of the condenser batteries belonging thereto.

A is the collecting balloon made of an aluminum magnesium alloy (electron metal, magnalium) of a specific gravity of 1.8 and a thickness of plate 0.1 to 0.2 mm. Insider there are eight strong vertical ribs of T-shaped section about 10 to 20 mm in height and about 3 mm in thickness with the projecting part directed inwards (indicated by a, b, c, d and so forth); they are riveted together to form a firm skeleton and are stiffened in a horizontal direction by two cross ribs. The ribs are further connected with one another internally and transversely by means of thin steel wires, whereby the balloon obtains great power of resistance and elasticity. Rolled plates of 0.1 to 0.2 mm in thickness made of magnalium alloy are then either soldered or riveted on this skeleton so that a fully metallic casing with smooth external surface is obtained Well silvered or coppered aluminum plated steel wires run from each rib to the fastening ring 2. Further, the coppered steel hawser L preferably twisted out of separate thin wires (shown in dotted lines in Figure 24) and which must be long enough to allow the balloon to rise in the desired height, leads to a metal roller or pulley 3 and from thence to a winch W, well insulated from the earth. By means of this winch, the balloon, which is filled with hydrogen, or helium, can be allowed to rise to a suitable height (300 to 5000 meters) and brought to the ground for recharging or repairs.

The actual current is taken directly through a friction contact from the metal roller 3 or from the wire, or even from the winch or simultaneously from all three by means of brushes (3, 3a and 3b). Beyond the brushes the conductor is divided, the paths being: --- firstly over 12 to the safety spark gap 8, from thence to the earth conductor E^1, and secondly over electromagnet S^1, point 13, to a second loose electromagnet having an adjustable coil S^2, then to the spark gap 7 and to the second earth conductor E^2. The actual working circuit is formed through the spark gap 7, condensers 5 and 6, and through the primary coil 9; here the static electricity formed by oscillatory discharges is accumulated and converted into high frequency electromagnetic oscillations. Between the electromagnets S^1 and S^2 at the crossing point 13, four condenser batteries are introduced which are only indicated diagrammatically in the drawings each by one condenser. Two of these batteries (16 and 18) are made as plate condensers and prolonged by regulating induction coils or spirals 17 and 19 while the two others (21 and 23) are induction condensers. As may be seen from the drawings each of the four condenser batteries 16, 18, 21 and 23 is connected by only one pole to the aerial or to the collector conductor. The second poles 17, 19, 22 and 24 are open. In the case of plate condensers having no inductive resistance an induction coil is inserted. The object of such a spiral or coil is the displacement of phase by the induction current by 1/4 periods, whilst that of the charging current of the condenser poles which lie free in the air, works back to the collector aerial. The consequence of this is that in discharges in the collector aerial the back inductive action of the free poles allows a higher voltage to be maintained in the aerial collecting conductor than would otherwise be the case. It has also been found that such a back action has an extremely favorable effect on the wear of the contacts. Of course the inductive effect may be regulated at will within the limits of the size of the induction coil, the length of the coil in action being adjustable by means of wire connection without induction (see Figure 24, No. 20).

S^1 and S^2 may also be provided with such regulating devices in the case of S^2 (illustrated by 11). If excess voltage be formed it is conducted to earth through the wire 12 and spark gap 8 or through any other suitable apparatus, since this formation would be dangerous for the other apparatus.

The small circles on the collector balloon indicate places at which zinc amalgam or gold amalgam or other photoelectric acting metals in the form of small patches in extremely thin layers (0.01 to 0.05 mm in thickness) are applied to the entire balloon as well as in greater thickness to the conducting network. The capacity of the collector is thereby considerably strengthened at the surface. The greatest possible effect in collecting may be obtained by polonium amalgams and the like. On the surface of the collector balloon metal points or spikes are also fixed along the ribs, which spikes serve particularly for collecting the collector charge. Since it is well known that the resistance of the spikes is less the sharper the spike is, for this purpose it is therefore extremely important to employ as sharp spikes as possible. Experiments made as regards these have shown that the formation of the body of the spike or point also plays a large part, for example, spikes made of bars or rollers with smooth surface, have a many times greater point resistance as collector accumulator spikes than those with rough surfaces. Various kinds of spike bodies have been experimented with for the collector balloons hereinbefore mentions. The best results were given by spikes which were made in the following way. Fine points made of steel, copper, nickel, or copper and nickel alloys, were fastened together in bundles and then placed as anode with the points in a suitable electrolyte (preferably in hydrochloric acid or muriate of iron solutions) and so treated with weak current at 2 to 3 volts pressure. After 2 to 3 hours according to the thickness of the spikes or pins the points become extremely sharp and the bodies of the spikes have a rough surface. The bundle can then be removed and the acid washed off with water. The spikes are then placed as cathode in a batch consisting of solution of gold, platinum, iridium, palladium or wolfram salts or their compounds and coated a the cathode galvanically with a thin layer of precious metal, which must however be sufficiently firm to protect them from atmospheric oxidation.

Such spikes act at a 20-fold lower voltage almost as well as the best and finest points made by mechanical means. Still better results are obtained if polonium or radium salts are added to the galvanic bat when forming he protective layer or coating. Such pins have a low resistance at their points and even at one volt and still lower pressures have an excellent collector action.

In Figure 24 the three unconnected poles are not connected with one another in parallel. That is quite possible in practice without altering the principle of the free pole. It is also preferable to interconnect in parallel to a common collector network, a series of collecting aerials.

Figure 25 shows a diagram for such an installation. A^1, A^2, A^3, A^4 are four metal collector balloons with gold or platinum coated spikes which are electrolytically made in the presence of polonium emanations or radium salts, which spikes or needles are connected over four electromagnets S^1, S^2, S^3, S^4, through an annular conductor R. From this annular conductor four wires run over four further electromagnets Sa, Sb, Sc, Sd, to the connecting point 13. There the conductor is divided, one branch passing over 12 and the safety spark gap 8 to the earth at E^1, the other over inductive resistance J and working spark gap 7 to the earth at E^2. The working circuit, consisting of the condenser 5 and 6 and a resonance motor M, such as hereinbefore described, is connected in proximity round the sparking gap section 7.

Instead of directly connecting the condenser motor of course the primary circuit for high frequency oscillatory current may also be inserted.

The condenser batteries are connected by one pole to the annular conductor R and can be either inductionless (16 and 18) or made as induction condensers as shown by 21 and 23. The free poles of the inductionless condensers are indicated by 17 and 19, those of the induction condensers by 22 and 24. As may be seen from the drawings all these poles 17, 22, 19, 24 may be interconnected in parallel through a second annular conductor without any fear that thereby the principle of the free pole connection will be injured. In addition to the advantages already set forth the parallel connection also allows of an equalization of the working pressure in the entire collector network. Suitable constructed and calculated induction coils 25 and 26 may also be inserted in the annular conductor of the free poles, by means of which a circuit may be formed in the secondary coils 27 and 28 which allows current produced in this annular conductor by fluctuations of the charges of the like appearances to be measured or otherwise utilized.

According to what has been hereinbefore stated separate collector balloons may be connected at equidistant stations distributed over the entire country, either connected directly with one another metallically or by means of intermediate suitably connected condenser batteries through high voltage conductors insulated from earth. The static electricity is converted through a spark gap into dynamic energy of a high number of oscillations and may in such form be coupled as a source of energy b y means of a suitable method f connecting, various precautions being observed and with special regulations. The wires leading from the collector balloons have hitherto been connected through an annular conductor without this endless connection, which can be regarded as an endless induction coil, being able to exert any action on the whole conductor system.

It has now been found that if the network conductor connecting the aerial collector balloons with one another is not made as a simple annular conductor, but preferably short circuited in the form of coils over a condenser battery or spark gap or through thermionic tubes or valves or audions, then the total collecting network exhibits quite new properties. The collection of atmospheric electricity is thereby not only increased but an alternating field may be easily produced in the collector network. Further, the atmospheric electrical forces showing themselves in the higher regions may also be directly obtained by induction. In Figures 26 and 28 a form of construction is shown on the basis of which the further foundations of the method will be more particularly explained.

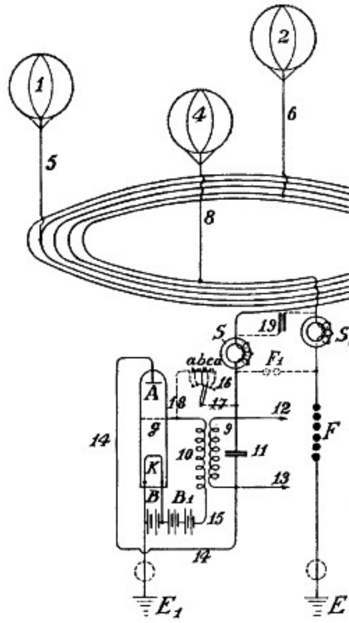


Fig. 26.

In Figure 26, 1, 2, 3, 4 are metal collector balloons, 5, 6, 7, 8 their metallic aerial conductors and I the actual collector network. This consists of five coils and is mounted on high voltage insulators in the air, in high voltage masts (or with a suitable construction of cable embedded in the earth). One coil has a diameter of 1 or 100 km or more. S and S^1 are two protective electromagnets, F the second safety section against excess voltage, E its earth conductor and E1 the earth conductor of the working section. When an absorption of static atmospheric electricity is effected through the four balloon collectors, the current in order to reach the earth connection E1 must flow spirally through the collector network over the electromagnet S, primary induction coil 9, conductor 14, anode A of the audion tube, incandescent cathode K, as the way over the electromagnet and safety spark gap F offers considerably greater resistance. Owing to the fact that the accumulated current flows in one direction, an electromagnetic alternating field is produced in the interior of the collector network coil, whereby the whole free electrons are directed more or less into the interior of the coil. An increased ionization of the atmosphere is thereby produced. In consequence of this the points mounted on the collector balloon show a considerably reduced resistance and therefore increased static charges between the points on the balloon and the surrounding atmosphere are produced. The result of this is a considerably increased collector effect.

A second effect which could not be obtained otherwise is obtained by the electromagnetic alternating field which running parallel to the earth surface, acts more or less with a diminishing or increasing effect on the earth magnetic field, whereby in the case of fluctuations in the current a return induction current of reversed sign is always produced in the collector coil by earth magnetism. Now if, however, a constantly pulsating continuous alternating field is produced as stated in the above collector network I, an alternating current of the same periodicity is produced also in the collecting network coil. As the same alternating field is further transmitted to the aerial balloon, the resistance to its points is thereby considerably reduced, whilst the collector action is considerably increased. A further advantage is that positive electrons which collect on the metal surfaces during the conversion into dynamic current produce a so-called drop of potential of the collector area. As an alternating field is present, the negative ions surrounding the collectors surfaces, when discharge of the collector surfaces takes place produce by the law of induction, an induction of reversed sign on the collector surface and so forth (that is to say again a positive charge). In addition to the advantages hereinbefore set forth, the construction of connecting conductors in coil form when of sufficiently large diameter, allows of a utilization of energy arising in higher regions also in the simplest way. As is well known electric discharges frequently take place at very great elevations which may be observed as St Elmo’s fire or northern lights. These energy quantities have no been available to be utilized up to now. By this invention all these kinds of energy, as they are of an electromagnetic nature and the direction of axis of the collector coils stands at right angles to the earth’s surface, can be more or less absorbed in the same way as a receiver in wireless telegraphy absorbs waves coming from a far distance. With a large diameter of the spiral it is possible to connect large surfaces and thereby to take up also large quantities of energy.

It is well known that large wireless stations in the summer months, and also in the tropics are very frequently unable to receive the signals in consequence of interruptions which are caused by atmospheric electricity, and this takes place with vertical coils of only 40 to 100 meters diameter. If on the contrary horizontal coils of 1 to 100 km diameter be employed very strong currents may be obtained through discharges which are constantly taking place in the atmosphere. Particularly in the tropics or still better in the polar regions where the northern lights are constantly present, large quantities of energy may probably be obtained in this way. A coil with several windings should act the best. In similar manner any alteration of the earth magnetism should act inductively on such a coil.

It is not at all unlikely that earthquakes and spots on the sun will also produce an induction in such collector coils of sufficient size. In similar manner this collector conductor will react on earth current more particularly when they are near the surface of the earth or even embedded in the earth. By combining the previous kind of current collectors so far as they are adapted for the improved system with the improved possibilities of obtaining current the quantities of free natural electricity which are to be obtained in the form of electricity are considerably increased.

In order to produce in the improved collector coil uniform current oscillations of an undamped nature so-called audion high vacuum or thermionic tubes of suitable connection are employed instead of the previously known spark gaps (Figure 26, Nos. 9-18). The main aerial current flows through electromagnet S (which in the case of a high number of alternations is not connected here but in the earth conductor E^1) and may be conveyed over the primary coils in the induction winding through wire 14 to the anode A of the high vacuum grid tube. Parallel with the induction resistance 9 a regulating capacity of suitable size, such as condenser 11 is inserted. In the lower part of the vacuum grid tube is arranged the incandescent filament or the cathode K which is fed through a battery B. From the battery B two branches run, one to the earth conductor E^1 and the other through battery B^1 and secondary coil 10 to the grid above *g* in the vacuum tube. By the method of connections shown in dotted lines, a desired voltage at the grid electrode *g* may also be produced through the wire 17 which is branched off from the main current conductor through switches 16 and some small condensers (*a, b, c, d*) connected in series, and conductor 18, without the battery B^1 being required.

The action of the entire system is somewhat as follows: --

On the connecting conductor of the aerial collector network being short circuited to earth, the condenser pole 11 is charged and slightly damped oscillations are formed in the short circuited existing oscillation circuit formed of the condenser 11 and self inductance 9. In consequence of the coupling through coil 10, fluctuations of voltage take place in the grid circuit 15 with the same frequency, which, fluctuations in turn influence the strength of the electrode current passing through the high vacuum amplifying tube and thus produce current fluctuations of the same frequency in the anode circuit. A permanent supply of energy to the oscillation circuits 9 and 10 consequently takes place, until a condition of balance is set up, in which the consumed oscillation energy is equal to that absorbed. Thereby constant undamped oscillations are now produced in the oscillation circuits 9-11.

For regular working of such oscillation producers high vacuum strengthening tubes are necessary and it is also necessary that the grid and anode voltages shall have a phase difference of 180° so that if the grid is negatively charged, then the anode is positively charged and vice versa. This necessary difference of phase may be obtained by most varied connections, for example, by placing the oscillation circuit in the grid circuit or by separating the oscillation circuit and inductive coupling from the anodes and the grid circuit and so forth.

A second important factor in this way of converting static atmospheric electricity into undamped oscillations is that care must be taken hat the grid and anode voltages have a certain relation to one another; the latter may be obtained by altering the coupling and a suitable selection of the self-induction in the grid circuit, or as shown by dotted lines 16, 17, 18 by means of a larger or smaller number of condensers of suitable size connected in series; in this case the battery B^1 may be omitted. With a suitable selection of the grid potential a glow discharge takes place between the grid *g* and the anode A, and accordingly at the grid there is a cathode drop and a dark space is formed. The size of this cathode drop is influenced by the ions which are emitted in the lower space in consequence of shock ionization of the incandescent cathodes K and pass through the grid in the upper space. On the other hand the number of ions passing through the grid is dependent on the voltage between the grid and the cathode. Thus is the grid voltage undergoes periodic fluctuations (as in the present case) the amount of the cathode drop at the grid fluctuates and consequently the internal resistance of the tube correspondingly fluctuates, so that when a back coupling of the feed circuit with the grid circuit takes place, the necessary means are afforded for producing undamped oscillations and of taking current, according to requirements from the collecting conductor.

The frequency of the undamped oscillations produced is with a suitably loose coupling equal to the self-frequency of the oscillation circuits 9 and 10. By a suitable selection of the self induction of the coil 9 and capacity 11 it is possible to extend from frequencies which produce electromagnetic oscillation of only a few meters wavelength down to the lowest practical alternating current frequency. For large installations a suitable number of frequency-producing tubes of the well-known high vacuum transmission tubes of 0.5 to 2 kw in size may be connected in parallel so that in this respect no difficulty exists.

The use of such tubes for producing undamped oscillations, and also the construction and method of inserting such transmission tubes in an accumulator or dynamo circuit is known and also that such oscillation producing tubes only work well at voltages of 1000 up to 4000 volts, so that on the contrary their use at lower voltages is considerably more difficult. By the use of high voltage static electricity this method of producing undamped oscillations as compared with that through spark gaps must be regarded as an ideal solution particularly for small installations of outputs of from 1 to 100 kw.

By the application of safety spark gaps, with interpolation of electromagnets, not only is short-circuiting avoided but also the taking up of current is regulated. Oscillation producers inserted in the above way form a constantly acting electromagnetic alternating field in the collector coil, whereby as already stated, a considerable accumulating effect takes place. The withdrawal wire or working wire is connected at 12 and 13, but current may be taken by means of a secondary coil which is firmly or movable mounted in any suitable way inside the large collector coil, i.e., in its electromagnetic alternating field, so long as the direction of its axis runs parallel with that of the main current collecting coil.

In producing undamped oscillations of a high frequency (50,000 per second or more) in the oscillation circuits 9 and 11, electromagnets S and S^1 must be inserted if the high frequency oscillations are not to penetrate the collector oil, between the oscillation producers and the collector coil. In all other cases they are connected shortly before the earthing (as in Figures 27 and 28).

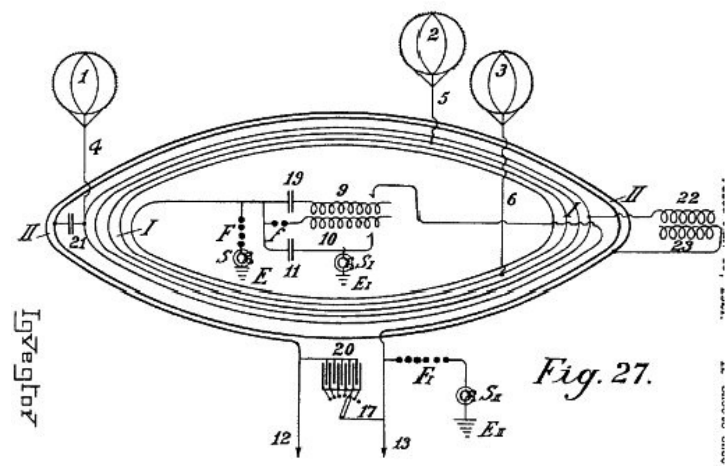


Fig. 27.

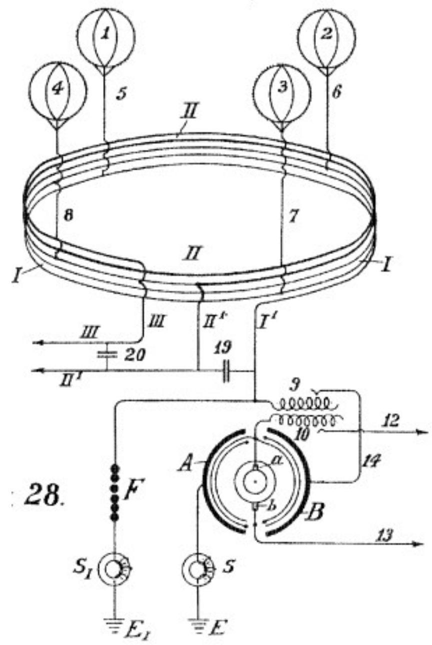
In Figure 27 a second method of construction of the connecting conductor of the balloon aerials is illustrated in the form of a coil. The main difference consists in that in addition to the connecting conductor I another annular conductor II is inserted parallel to the former on the high voltage masts in the air (or embedded as a cable in the earth) but both in te form of a coil. The connecting wire of the balloon aerials is indicated as a primary conductor and also as a current producing network; the other is the consumption network and is not in unipolar connection with the current producing network.

In Figure 27 the current producing network I is shown with three balloon collectors 1, 2, 3 and aerial conductors 4, 5, 6; it is short-circuited through condenser 19 and inductance 9. The oscillation forming circuit consists in this diagram of spark gap f, inductance 10, and condenser 11; the earth wire E, is connected to earth over electromagnet S^1. F s the safety spark gap which is also connected to earth through a second electromagnet S at E. On connecting up the condenser circuit 11 this is charged over the spark gap f whereby an oscillatory discharge is formed. This discharging current acts through inductance 10 on the inductively coupled secondary 9, whereby in the producing network a modification of the potential of the condenser 19 is produced. The consequence of this is that oscillations arise in the coil shaped producer network. These oscillations induce a current in the secondary

circuit II, which has a smaller number of windings and a less resistance, the voltage of which, according to the proportion of the number of windings and of the ohmic resistance, is considerably lower whilst the current strength is greater.

In order to convert the current thus obtained into current of an undamped character, and to tune its wavelengths, a sufficiently large regulatable capacity 20 in inserted between the ends 12 and 13 of the secondary conductor II. Here also current may be taken without an earthy conductor, but it is advisable to insert a safety spark gap E1 and to connect this with the earth over an electromagnet S2.

The producer network may be connected with the working network II over an inductionless condenser 21 or over an induction condenser 22, 23. In this case the secondary conductor is unipolarly connected with the energy conductor.



In Figure 28 the connecting conductor between the separate accumulator balloons is carried out according to the autotransformer principle. The collecting coil connects four aerial balloons 1, 2, 3, 4, the windings of which are not made side by side but one above the other. In Figure 28 the collector coil I is shown with a thin line, the metallically connected prolongation coils II with a thick line. Between the ends I^1 and II^1 of the energy network I a regulating capacity 19 is inserted. The wire I^1 is connected with the output wire and with the spark gap F.

As transformer of the atmospheric electricity an arrangement is employed which consists in using rotary pairs of condensers in which the one stator surface B is connected with the main current, whilst the other A is connected with the earth pole. Between these pairs of short-circuited condensers are caused to rotate from which the converted current can be taken by means of two collector rings and brushes, in the form of an alternating current, the frequency of which is dependent on the number of balloons and the revolutions of the rotor. As the alternating current formed in the rotor can act, in this improved method of connection described in this invention, through coils 1 on the inductance 9, an increase or diminution of the feed current in I can be obtained according to the direction of the current by back induction. Current oscillations of uniform rhythm thereby result in the coil shaped windings of the produce network.

As the ends of this conductor are short-circuited through the regulatable condenser 19 these rhythms produce short-circuited undamped oscillations in the energy conductor, the periodicity and wave lengths of which oscillations can be adjusted according to desire by altering the capacity 19 to a given wavelength and therewith also to a given frequency. These currents may also be employed in this form directly as working current through the conductors II^1 and III. By inserting the condenser 20 a connection between these conductors may also be made, whereby harmonic oscillations of desired wavelengths are formed. By this means quite new effects as regards current distribution are obtained. The withdrawal of current can even take place without direct wire connection if, at a suitable point in the interior of the producing network (quite immaterially whether this has a diameter of 1 or 100 km) a coil tuned to these wavelengths and of the desired capacity is firmly or movably mounted in the aerial conductor in such a way that is axial direction is in parallel with that of the collector coil. In this case a current is induced in the producing network, the size of which is dependent on the total capacity and resistance and also on the periodicity employed. A possibility is thereby afforded in future, of taking energy from the producer network by wireless means. As thereby in addition to atmospheric electricity also magnetic earth currents and energy from the higher atmosphere (at leas partially may be simultaneously obtained, this last system for collecting the atmospheric energy is of particular importance for the future.

Of course everywhere instead of spark gaps grid vacuum tubes may be employed as producers for undamped oscillations. The separate coils of the producer network with large diameters may be connected with one another through separate conductors all in parallel or all in series or in groups in series. By regulating the number of oscillations and also the extent of the voltage more or less large collector coils of this kind may be employed. The coils may also be divided spirally over the entire section. The coils may be carried out in angular form or also in triangular, quadrangular, hexagonal or octagonal form.

Of course wires may be carried from a suitable place to the center or also laterally which serve the current waves as guides. This is necessary when the currents have to be conducted over mountains and valley and so forth. In all these cases the current must be converted into a current of suitable periodicity.

As already hereinbefore mentioned separate collecting balloons may be directly metallically interconnected at equidistant stations distributed over the entire country or may be connected by interpolation of suitable condenser batteries by means of high voltage conductors. The static electricity is converted through a spark gap into dynamic energy of a high number of oscillations, and could then in such forms, wit a suitable arrangement of the connections, observing various measures of protection, be employed as source of energy after separate or special regulation.

According to this invention in order to increase the collecting effect of the balloon in the aerial collector conductor or in the earth wire, radiating collectors are employed. These consist either of incandescent metal or oxide electrodes in the form of vacuum grid tubes, or electric arcs (mercury and the like electrodes), Nernst lamps, or finally flames of various kinds may be simply connected with the respective conductor.

It is well known that energy can be drawn of from a cathode consisting of an incandescent body opposite an anode charged with positive electricity (vacuum grid tube). Hitherto however, a cathode was always first directly placed opposite an anode, and secondly the system always consisted of a closed circuit.

Now if we dispense with the ordinary ideas in forming light or flame arcs in which a cathode must always stand directly opposite an anode, charged to a high potential or another body freely floating in the air, or regard the incandescent cathode only as a source of unipolar discharge (which represent group and point discharges in electrostatic machines similar to unipolar discharges), it may be ascertained that incandescent cathodes and less perfectly all incandescent radiators, flames and the like admit of relatively large current densities and allow large quantities of electric energy to radiate into the open space in the form of electron streams as transmitters.

The object of this invention is as described below, if such incandescent oxide electrodes or other incandescent radiators or flames are not freely suspended in space but connected metallically with the earth so that they can be charged with negative terrestrial electricity, these radiators possess the property of absorbing the free positive electrical charges contained in the air space surrounding them (that is to say of collecting them and conducting them to earth). They can therefore serve as collectors and have, in comparison to the action of the spikes, or points, a very large radius of action R; the effective capacity of these collectors is much greater than the geometrical capacity (R_{o-}) calculated in an electrostatic sense.

Now as our earth is surrounded as is well known with an electrostatic field and the difference of potential

$$\frac{\delta V}{\delta h}$$

of the earth field according to the latest investigations, is in summer about 60 to 100 volts and in winter 300 to 500 volts per meter of difference in height (δh), a simple calculation gives the result that when such a radiation collector or flame collector is arranged for example on the ground, and a second one is mounted vertically over it at a distance of 2000 meters and both are connected by a conducting cable, there is a difference in potential in summer of about 2,000,000 volts and in winter even of 6,000,000 volts and more.

According to Stefan Boltzmann's law of radiation, the quantity of energy which an incandescent surface (temperature T) of 1 sq cm radiates in a unit of time into the open air (temperature T_o) is expressed by the following formula:

$S = \sigma (T^4 - T^4_o)$ watt./sq cm.

And the universal radiation constant σ is according to the latest researches of Ferry (*Annales de Chimie et de Physique*, 17: 267 [1909]) equal to 6.30 x 10^{-12} watt/sq cm.

Now if an in incandescent surface of 1 sq cm shows, as compared with the surrounding space a periodic fall of potential δV it radiates (independent of the current direction, that is to say of the sign) in accordance with the above formula, for example at a temperature of 3725° C an energy of 1.6 kw/sq cm/second. As for the radiation the same value can be calculated for the collection of energy, but reversed. Now, as carbon electrodes at the temperature of the electric arc support on the current basis a current density up to from 60 to 65 amperes per sq cm no difficulties will result in this direction in employing radiating collectors as accumulators.

If the earth be regarded as a cosmically insulated condenser in the sense of geometrical electrostatics *x* there results from the geometric (compare Edwald Rasch: *Das Elektrische Bogenlicht* [The Electric Arc Light], page 169) capacity of the earth according to Chwolson:

For negative charging 1.3 x 10^6 Coulomb

For negative potential V = 10 x 10^8 volts.

From this there results however, EJT = 24.7 x 10^{24} watt/sec. Now if it is desired to make a theoretic short circuit through an earthed flame collector this would represent an electric total work of about 79,500 x 10^{10} kilowatt years. As the earth must be regarded as a rotating mechanism which thermodynamically, electromagnetically and also kinematically coupled with the sun and star system by cosmic radiations and gravitation a diminution of the electric energy of the earth field is not to be feared. The energies which the incandescent collectors would withdraw from the earth field can only case by the withdrawal of motor work a lowering of the earth temperature (temperature $T_E = 300$) and reduce this to that of the world space (T = O) by using the entire energy. This is however not the case as the earth does not represent a cosmically entirely insulated system. On the contrary there is conveyed to the same according to the recent value corrected by Perry for the solar constants through the radiation from the sun an energy of 18,500 x 10^{10} kw. Accordingly, any lowering of the earth temperature (T_E) without a simultaneous lowering of the sun's temperature (T_s) would contradict Stefan Boltzmann's law of radiation.

$S = \sigma (s^4 - T^4)$.

From this it must be concluded that if the earth temperature (T_E) sinks the total radiation S absorbed by the earth increases, and further also that the secular speed of cooling of the earth is directly dependent on that of the sun and the other radiators cosmically coupled with the sun and is connected most closely with these.

The incandescent radiation collectors may, according to this invention, be employed for collecting atmospheric electricity if they (1) are charged with the negative earth electricity (that is to say when they are directly connected by means of a metallic conductor with the earth) and (2) if large capacities (metal surfaces) charged with electricity are mounted opposite them as positive poles in the air. This is regarded as the main feature of the present invention as without these inventive ideas it would not be possible to collect with an incandescent collector, sufficiently large quantities of the electrical charges contained in the atmosphere as the technology requires; the radius of action of the flame collectors would also be too small, especially if it be considered that the very small surface density (energy density) (σ about = 2 x 7 . 10^9 St. E. per sq cm) does not allow of large quantities of charge being absorbed from the atmosphere.

x) Calculated according to Poisson's calculation:

$\Delta V = -4\pi\delta$; as here the alteration of the potential or potential gradients only takes place in the direction o the normal, this calculation assumes the simple form

$$\delta = \frac{1}{4\pi} \times \frac{\delta^2 V}{\delta n^2}$$

It has indeed already been proposed to employ flame collectors for collecting atmospheric electricity and it is known that their collecting effect is substantially greater opposite the points. It is however, not known that the quantities of current which could hitherto be obtained are too small for technical purposes. According to my experiments the reason for this is to be found in the too small capacities of the collector conductor poles. If such flame or radiating collectors have no or only small positive surfaces, their radius of action for large technical purposes is too small. If the incandescent collectors be constantly kept in movement in the air they may collect more according to the speed of the movement, but this again is not capable of being carried out in practice.

By this invention the collector effect is considerably increased by a body charged with a positive potential and of the best possible capacity being also held floating (without direct earth connection) opposite such an incandescent collector which is held floating in the air at a desired height. If for example, a collecting balloon of sheet metal or of metalized balloon fabric be caused to mount to 300 up to 3000 meters in the air and as positive pole it is brought opposite such a radiating collector connected by a conductor to the earth, quite different results are obtained.

The metallic balloon shell (with a large surface) is charged to a high potential by the atmospheric electricity. This potential is greater the higher the collecting balloon is above the incandescent collector. The positive electricity acts concentratedly on the anode floating in the air as it is attracted through the radiation shock ionization, proceeding from the incandescent cathode. The consequence of this is that the radius of action of the incandescent cathode collector is considerably increased and thereby also the collection effect of the collecting balloon surface. Further the large capacity of the anode floating in the air plays therefore an important part because it allows of the taking o large charges, and thereby a more uniform current is obtained even when there is a large consumption: this cannot be the case with small surfaces.

In the present case the metallic collecting balloon is a positive anode floating in the air and the end of the earth conductor of this balloon serves as positive pole surface opposite the surface of the radiating incandescent cathode, which in turn is charged with negative earth electricity being conductively connected to earth.

The process may be carried out by two such contacts (negative incandescent cathode and anode end of a capacity floating in the air) a condenser and an inductive resistance being switched on in parallel, whereby simultaneously undamped oscillations may be formed.

In very large installations it is advisable to connect two such radiating collectors in series. Thus an arc light incandescent cathode may be placed below on the open ground and an incandescent cathode which is heated by special electromagnetic currents be located high in the air. Of course for this the special vacuum Liebig tubes wit or without grids may also be employed. An ordinary arc lamp with oxide electrodes may be introduced on the ground and the positive pole is not directly connected with the collecting balloon, but through the upper incandescent cathode or over a condenser. The method of connecting the incandescent cathode floating in the air may be seen in Figures 29-33.

B is the air balloon, K a Cardan ring (connection with the hawser), C the balloon, L a good connecting cable, P a positive pole, N negative incandescent cathode, and E earth conductor.

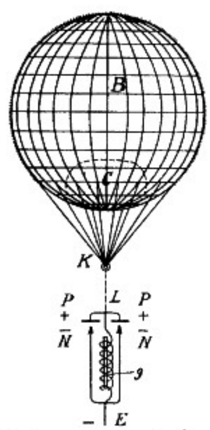


Fig. 29.

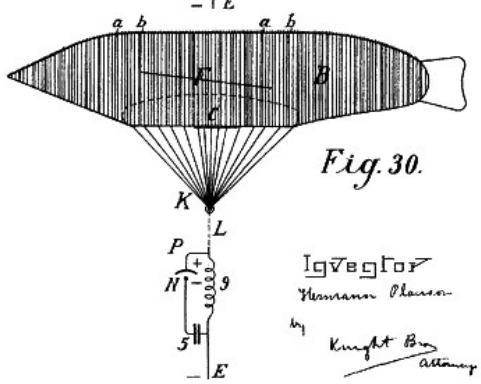
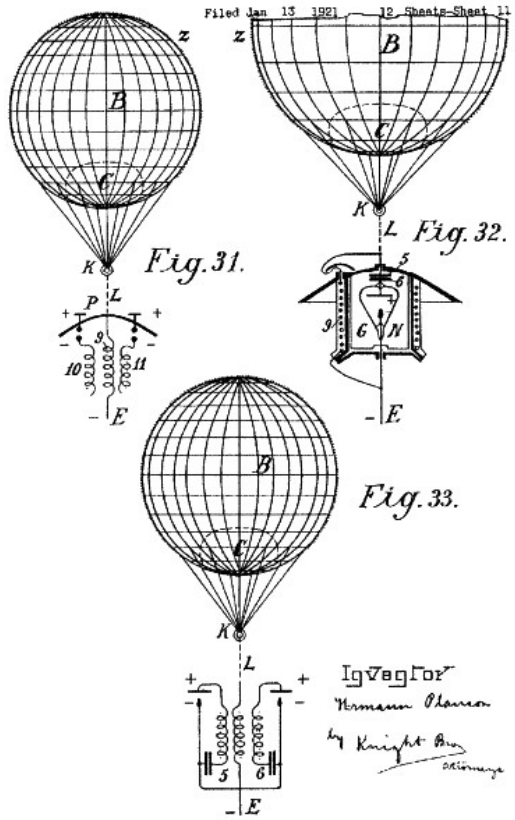


Fig. 30.

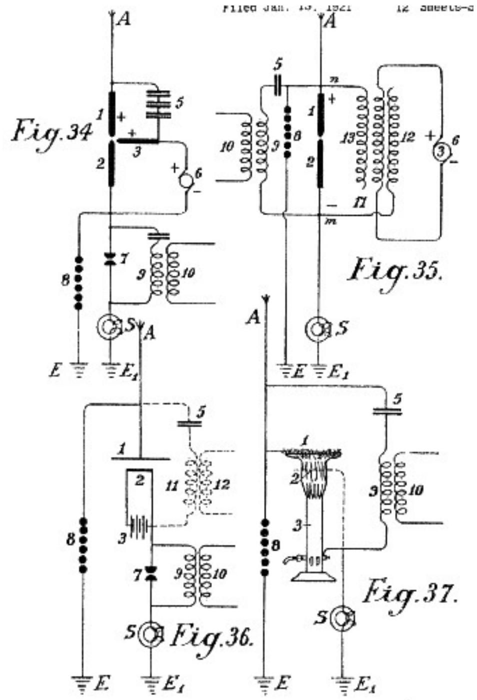
Figure 29 represents the simplest form of construction. If electric oscillations are produced below on the ground by means of a carbon arc lamp or in other suitable way a considerably greater electric resistance is opposed to that in the direct way by inserting an electrical inductive resistance 9. Consequently between P and N, a voltage is formed, and as, over N and P only an inductionless ohmic resistance is present, a spark will spring over so long as the separate induction co-efficients and the like are correctly calculated. The consequence of this is that the oxide electrode (carbon or the like) is rendered incandescent and then shows as incandescent cathode an increased collecting effect. The positive poles must be substantially larger than

the negative in order that they may not also become incandescent. As they are further connected with the large balloon area which has a large capacity and is charged at high voltage, an incandescent body which is held floating in the air and a positive pole which can collect large capacities is thereby obtained in the simplest way. The incandescent cathode is first caused to become incandescent by means of separate energy produced on the earth, and then maintained by the energy collected from the atmosphere.

Figure 30 only shows the difference that instead of a round balloon a cigar-shaped one (of metal or metalized fabric) may be employed and also a condenser 5 is inserted between the incandescent cathode and the earth conductor so that a short circuited oscillation circuit over P.N. 5 and 9 is obtained. This has the advantage that quite small quantities of electricity cause the cathode to become incandescent and much larger cathode bodies may be rendered incandescent.



In this form of construction both the incandescent cathode and also the positive electrode may be enclosed in a vacuum chamber as may be seen in Figure 32. A cable L is carried well insulated through the cover of a vessel and ends in a condenser disc 5. The cover is arched in order to keep off the rain. The vessel is entirely or partially made of magnetic metal and well-insulated inside and outside. Opposite the disc 5 another disc 6 and on this again a positive pile of the vacuum tube g with the incandescent cathode (oxide electrode) N is arranged. The negative electrode is on the one hand connected with the earth conductor E, and on the other hand with the inductive resistance 9 which is also connected with the cable L with the positive pole and wound round the vessel in coils. The action is exactly the same as that in Figure 29 only instead of an open incandescent cathode one enclosed in vacuo is employed. As in such collectors only small bodies can be brought to incandescence in large installations a plurality of such vacuum tubes must be inserted in proximity to one another. According to the previous constructions Figures 31 and 33 are quite self evident without further explanations.



Figures 34-37 represent further diagrams of connections over radiating and flame collectors, and in fact, how they are to be arranged on the ground.

Figure 34 shows an arc light collector with oxide electrodes for direct current and its connection; Figure 35 a similar one for alternating current, Figure 36 an incandescent collector with a Nernst lamp and Figure 37 a similar one with a gas flame.

The positive pole 1 of the radiating collectors is always directly connected to the aerial collecting conductor A. In Figure 34 this is further connected over the condenser battery 5 with a second positive electrode 3. The direct current dynamo *b* produces current which flows over between the electrodes 3 and 2 as an arc light. On the formation of an arc the negative incandescent electrode 2 absorbs electricity from the positive poles standing opposite it and highly charged with atmospheric electricity and conveys the same to the working circuit. The spark gap 7, inductive resistance 9 and induction coil 10 are like the ones previously described. The protective electromagnet S guards the installation against earth circuiting, the safety spark gap 8 from excess voltage or overcharging.

In Figure 35 the connection is so far altered that the alternating current dynamo feeds the exciting coil 11 of the induction condenser. 12 is its negative and 13 its positive pole; if the coil 3 on the magnet core of the dynamo is correctly calculated and the periodicity of the alternating current is sufficiently high an arc light can be formed between the two poles 1 and 2. As the cathode 2 is connected with the negatively charged earth, and therefore always acts as a negative pole, a form of rectification of the alternating current produced by the dynamo 3 is obtained, the second half of the period is always suppressed. The working circuit may be carried out in the same way as in Figure 34; the working gap 7 may however be dispensed with, and instead thereof between the points m and n a condenser 5 and an induction resistance 9 may be inserted from which the current is taken inductively.

Figure 36 represents a form of construction similar to Figure 34 only that here instead of an arc lamp a Nernst incandescent body is employed. The Nernst lamp is fed through the battery 3. The working section is connected with the negative pole, the safety spark gap with the + poles. The working spark gap 7 may also be dispensed with and the current for it taken at 12 over the oscillation circuit 5, 11 (shown in dotted lines).

Flame collectors (Figure 37) may also be employed according to this invention. The wire network 1 is connected with the aerial collector conductor A and the burner with the earth. At the upper end of the latter, long points are provided which project into the flame. The positive electrode is connected with the negative over a condenser 5 and the induction coil 9 with the earth.

The novelty in this invention is firstly, the use of incandescent cathodes opposite positive poles which are connected with large metallic capacities as automatic collecting surfaces, (2) the connection of the incandescent cathodes with the earth whereby, in addition to the electricity conveyed to them from the battery or machine which causes the incandescing, also the negative charge of the earth potential is conveyed, and (3) the connection of the positive and negative poles of the radiating collectors over a condenser circuit alone or with the introduction of a suitable inductive resistance, whereby simultaneously an oscillatory oscillation circuit may be obtained. The collecting effect is by these methods quite considerably increased.

I declare that what I claim is: --- [Claims not included here]

British Patent # 157,262
(10 July 1922)

Improvements in Electric Motors

Hermann Plauson // Otto Traun's Forchungs-Laboratorium GmbH

This invention relates to that type of motor in which rotation is produced by means of the attraction and repulsion of surfaces carrying charges of electricity.

According to this invention a stator and rotor are formed of condensor surfaces and charges of electricity thereon imposed in the form of alternating currents of high frequency.

The invention is more particularly described with reference to the accompanying drawing in which: ---

Figure 1 shows a simple form of motor and feed.

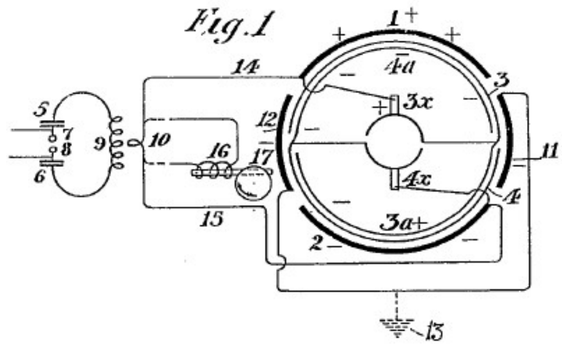


Figure 2 is a modification of Figure 1.

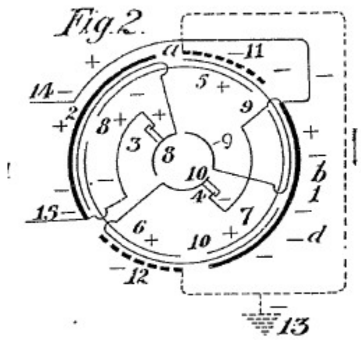
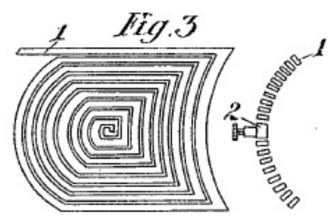
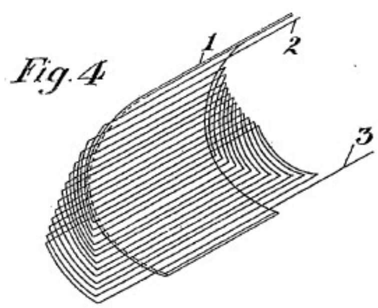


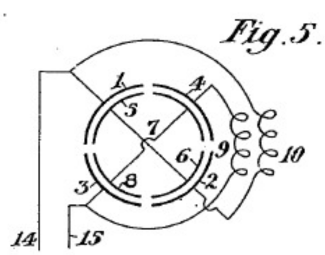
Figure 3 shows one form of a spiral condenser surface.

Figure 4 shows a wire wound condenser surface.

Figure 5 is a diagram of one type of rotor,







The inner plates of the condenser 5 and 6 are charged from a spark gap 7, 8 connected to a source of energy of sufficiently high pressure (alternating or direct current), until the potential has risen so far that a spark springs over.

The spark gap 7, 8 forms with the condenser 5 and self-inductance 9 and condenser 6 a closed oscillatory circuit and alternating currents of high frequency will be produced in this circuit. The high frequency current produced in the primary circuit 9 excite by induction in the secondary circuit 10 currents of the same periodicity.

The improved type of motor is fed by the discharges produced by the induction in the secondary circuit.

Hitherto only Tesla's motor system (shown diagrammatically in Figure 1, 16 and 17) was known for this purpose. The above-mentioned diagram is only shown for illustrating the fundamental principle. It has however no practical interest for carrying out large machines by reason of the impossibility of the regulation and the low efficiency.

Now according to this process, all these defects are overcome by the construction of a machine which is applicable for high frequency currents and of a more or less undamped nature. The difference between the principle of construction of these motors as compared with those hitherto customary consists in that the motor is not based on the principle of magnetic induction only (as have been all motors hitherto and also Tesla's motors).

It has been fund that the machine constructed according to Figure 1 cannot only be fed directly with static electricity but if it is connected to a source of high frequency current it will operate.

The applicants call this new type of motors 'condenser motors' to differentiate them from hitherto existing types.

The simplest form of construction of such condenser motors is shown in Figure 1, and this motor may be fed with high frequency alternating currents.

At a given moment positive electricity is charged by means of the lead 14 to the stator surface 1 and to the brush 3x (Figure 1). The brush 3x is connected with the rotor condenser surface 3, so that both the stator surface 1 and also the rotor surface 3 is charged with positive electricity. The stator surface 1 and the rotor surface 3 being both charged with positive electricity and the second rotor surfaces 4 and 4a by brushes 4x with negative electricity, such motors can then be started by providing intermediate stator surfaces 11, 12, the earth connection 13 of one of which is broken by a switch (not shown) according to the direction of rotation desires, or alternatively the motor may be started by a separate source of alternating current in a manner similar to the starting of synchronous motors of known construction. After a half revolution of the rotor the brush 3x comes in contact with the second collector surface 4 so that now this surface is connected by the brush 3x with the stator surface 1 and the brush 4x with the collector surface 3. Consequently with a reverse direction of current through the second half of the oscillation period all the hereinbefore mentioned effects take place in the reverse direction which, however, produces no alteration in the direction of rotation because the dead points between two directions of oscillation are overcome by inertia.

Although this motor is easy to start it can only be employed for small experimental and measuring purposes because the stator and rotor surfaces are made of solid metal and are heated by Foucalt (eddy) currents. In spite of its simplicity and its unsuitability for use in practice it must however be regarded as a basic type for technical calculations.

The condenser motor shown in Figure 2 differs from Figure 1 by the rotor surfaces consisting of six condenser surfaces connected one behind the other in series and they are connected with three collector surfaces, so that at any one moment only two adjacent collector surfaces come under the two brushes (3 and 4). In its other actions it corresponds to Figure 1. The leads 14 and 15 may be connected either to the ends of the secondary coil 10 or directly with the source of energy. The outer thicker line indicates the stator surfaces 1 and 2 (that is to say the unmoving part of the motor), 11 and 12 shown by thick dotted lines means earthed additional poles of the stator, 8, 9, and 10 are the outer parts of the rotor condenser surfaces which in turn are connected with the collector surfaces 8, 9, and 10. 5, 6, and 7 are the inner parts of the condenser surfaces of the rotor and 3 and 4 are brushes.

Hitherto stator and rotor surfaces of compact metal have been spoken of. These however become highly heated with eddy currents and hardly yield 10-15% of useful effect. In examining into such small useful effects it was found that certain forms of metal sections in the stator and condenser surfaces highly increase these. It was then further found that if slots or notches be cut in the metal surfaces of the stator and rotor in the form of a spiral, not only was a higher useful effect possible, but also an easier starting and even a regulation could be obtained.

Experiments have shown that by such a form of construction it is possible to build a very useful motor for high frequency alternating currents more particularly those of an undamped nature.

If for example the system of construction of a stator shown in Figure 1, but four polar, be taken and the system of rotor construction shown diagrammatically in Figure 5, but with the form of construction of the condensers of the stator as well as of the rotor according to Figure 3, a condenser motor is obtained which works well in either direction for high frequency alternating current. It was also observed that the motors in such forms of construction were found to be more sensitive to resonance effects. Such a motor then works the best if stator and rotor surfaces have equal capacity and self-inductance so that the windings both in the stator and also in the rotor are in resonance.

A motor constructed according to the foregoing kind is already fully technically applicable. But even these motors have a series of faults, more particularly in their building construction. For example, the attachment of the spiral condenser surfaces both of the stator and of the rotor sown in Figure 3 are in practice difficult to carry out. Therefore in practice the condenser and stator surfaces are simply wound of wire or bands in the form shown in Figure 4. Such stator and rotor surfaces may, without further difficulty, be regarded as electromagnetic poles, although they are not made of iron as is the case in electromagnets. Such machines may be spoken of directly as motors for high frequency alternating currents in which the separate pole surfaces consists of wound induction condenser surfaces of which one is sound on the stator and the other on the rotor.

If the coil as shown in Figure 4 be made of well insulated wires the coil can be embedded in insulating material either for the stator or motor surfaces as has already been done in the case of ordinary single and multiphase motors. At the same time the possibility is afforded by increasing the number of turns to produce a greater or smaller alteration of the self induction co-efficients.

In Figure 5 is shown a modified construction of a rotor for a four pole motor consisting of four condenser surfaces 1, 2, 3, 4, of which 1 and 2 are connected though an iductance 9 coupled with the coil 10. Four inner surfaces 5, 6, 7, 8 are provided of which 5 and 6 are directly connected also 7 and 8 similarly connected.

The pairs of like poles are connected by wires 14 and 15 to the source of energy. By a suitable selection of the values of the reactance and capacity in these circuits resonance circuits may be formed.

Having now particularly described and ascertain the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is: --- [Claims not included here]

British Patent # 157,263

Process & Apparatus for Converting Static Atmospheric Electrical Energy into Dynamic Electrical Energy of any Suitable High Periodicity

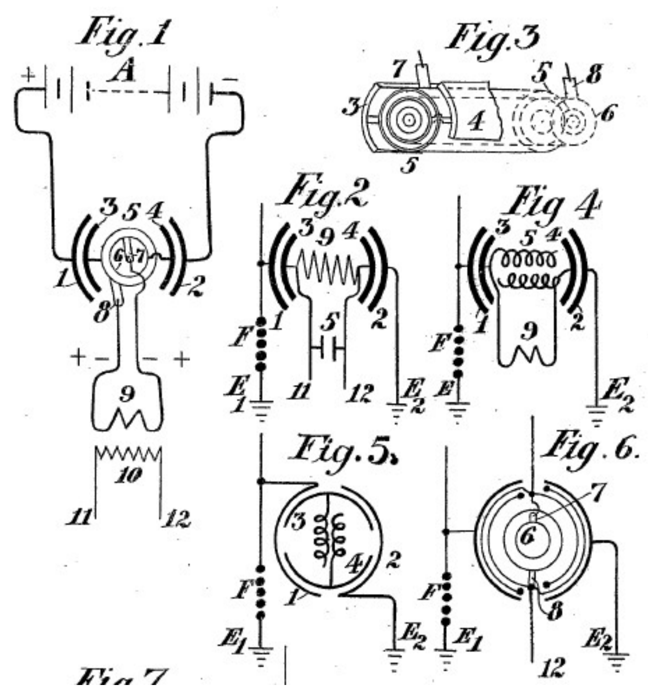
Hermann Plauson // H.O. Traun's Forschungs-Laboratorium GmbH

Static aerial electricity in the form of direct current can be converted by using spark gaps and with the assistance of oscillatory circuits into dynamic electrical wave energy of a high number of alternations of a more or less undamped nature and in such form --- either direct or by means of a special kind of resonance or 'condenser motors' --- ready to be utilized for technical purposes as mechanical energy.

For small installations this system may be very well employed; about 100 horsepower may be stated as practical limit. In constructions of larger aggregate difficulties as regards the spark gaps however increase considerably. Further it is desirable to convert the accumulated currents of from 100 to 1000 periods which may then be used for the ordinary types of alternating current machines instead of into electromagnetic waves of a high number of alternations.

In experimenting with condenser motors the construction of which forms the object of British Patent # 157,262 it was observed that the rotor, if one pole of the stator surface be connected with the aerials collecting aerial electricity and the other pole with the earth, not only could act as a motor, but if vice versa the rotor connection with the stator be interrupted and the rotor caused to rotate by means of another motor, that when the brushes supply an alternating current the periodicity of which is dependent on the number of poles and the revolutions of the rotor. Such an apparatus may therefore be regarded as a transformer of static into dynamic electrical energy.

The invention is more particularly described with reference to the accompanying diagrams in which: ---



In Figure 1A is a strong accumulator battery, 1 and 2 are the outer poles of the transformer, consisting of simple metallic plates or are as shown in Figures 8-11, made of wire coils without an electromagnet being present. Between these poles an armature is revolubly mounted on a shaft, which armature also consists of two similar cylindrically curved plates 3 and 4. These are metallically connected with two collector rings 5 and 6 on which two brushes 7 and 8 freely run which again are short-circuited with one another over a primary coil 9. 10 is the secondary coil with the free ends 11 and 12. If through the accumulator battery the stator plate 1 is charged with positive electricity, it induces a charge of reverse sign on the rotor surface 3 which is connected by the brushes 7 and 8 over the primary coil 9 with the second rotor surface 4. This latter is therefore charged with positive electricity, which in turn induces negative electricity on the stator surface 2/ Up to this moment everything takes place in the same way as if two condensers were connected one behind the other in the current circuit A. If however, by means of mechanical power, this rotor be caused to rotate, the surface conditions are altered. After a quarter revolution the rotor plates are between the stator plates and therefore no condenser surface faces another. By this means however, the capacity of the entire system is reduced to a minimum and a change of current will also result in the main 9. Now if the rotor be turned further through 90 degrees by mechanical energy the rotor plate 3 comes opposite the stator plate 2 and the rotor plate 4 opposite the stator plate 1, so that then the rotor pates are in a field of reverse sign. A fresh charge of current in the reverse direction now runs through the primary coil 9. After a further half revolution the same action is repeated so that after a full revolution the initial condition is again produced. The result of such a revolution is an alternating current the periodicity of which is equal to the number of revolution. In practice of course not two poles but as many poles as possible would be employed because thereby the number of alternations would e considerably increased. The primary alternating current thus obtained induces in the secondary circuit an alternating current the potential of which is dependent on the winding of the coil. Figure 7 shows a multipolar machine.

If the stator surface 1, instead of being connected with the battery be connected with a collecting aerial network and the other stator surface 2 be directly earthed, but the rotor wich is otherwise constructed as hereinbefore, be rotated by a separate motor a much stronger alternating current results which is to be ascribed to the circumstance that a much higher potential can be charged on the pole surfaces of the stator by reason of the higher pressure of the static electricity than where accumulators are employed. By this means the transformer has of course much larger quantities of energy supplied to it.

Figure 2 shows a mode of connections. The stator surface 1 is connected with the aerial antennae which is connected through the safety spark gap F to earth at E1. The stator surface 2 is directly earthed at E2. The inner revoluble rotor surfaces 3 and 4 are interconnected by means of an induction coil which is constructed directly in the motor. The current is taken as in Figure 1 up to collector rings by means of brushes, which are not shown for the sake of clearness, and further conveyed through the conductors 11 and 12. Between these a condenser 5 may be inserted. There is thereby formed a short oscillatory oscillation circuit free from spark gaps, which circuit consists of the induction coil 9 and condenser 5 and is fed by the periodic charging current impulse. By this means the possibility is afforded of obtaining a kind of current which is characterized by longer periods and is undamped and oscillatory. Of course a simple alternating current may be obtained by cutting out the condenser.

Instead of the induction coil the condenser may also b constructed in the rotor. His can be carried out in such a way that its ends serve directly as collector rings for taking current through the brushes. In Figure 3 such a motor is sketched in perspective, 3 and 4 are the rotor surfaces, 5 and 6 are the condenser surfaces constructed to form part of the rotor consisting of two co-axial cylinders fitting one in the other in such a way that free room is left for the brushes 7 on one end of the condenser cylinder 6.

The condenser may be made in the form of a cylindrically wound spiral forming the capacity and reactance as shown in Figure 4. A further type of transformer is shown in Figure 5. The difference consists in the stator and rotor surfaces not only each assuming a quarter of the circuit but almost the half. By this means the space and the effective condenser surface is better utilized. Charge is produced only when the rotor surfaces face the full scope of the stator surfaces.

In addition a condition is obtained in which the stator surfaces are inductively connected by the rotor surfaces. The consequence of this is that an alternating current simultaneously results which is produced without sparking otherwise the connection is as before.

Figure 6 shows the alternation of the rotor surfaces; the rotor here consists of two cylindrical condenser plates arranged concentrically, each divided into two halves and connected so that half the inner cylinder is connected to half the outer. Such a machine shows the more complete transformer action.

Fig.7.

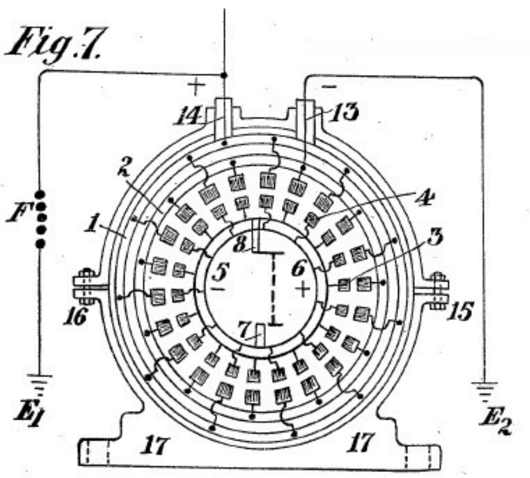


Figure 7 shows a four polar transformer. It consists of a metal casing, the lower half of which is fastened with the foundation plates 17 to the support or foundation. The upper half, the cover, is connected by bolts 15 and 16 firmly with the under part. This upper sleeve or casing is insulated from the under part. Two rings 1 and 2 are cylindrically constructed in the casing. The ring 1 is metallically connected with the collector aerial and the ring 2 with the earth. On both rings an equal number of stator surfaces are mounted side by side but well insulated from one another and thus form an electrostatic field similar to the electromagnetic in many alternating current machines. The rotor consists in similar manner of two rings 5 and 6 on which an equal number of rotor surfaces are fixed so that each stator surface faces a rotor surface. By the brushes 7 and 8 the alternating current formed is removed from the collector. The charge is conveyed by the conductor 14 to and by 13 away. If this rotor be then rotated by means of a motor the positive and negative fields precisely as in the case of magnetizing will alter and thereby an alternating current is formed in the rotor, the periods of which are dependent on the number of the poles and the revolutions per second.

At the commencement it was thought that this apparatus could only be regarded as alternating current converters, but it was soon found that much more energy was necessary to rotate the rotor than might be necessary to overcome the friction. It was then found that the considerable expenditure of energy for rotating the rotor was caused by a conductor being moved through strongly electrostatic fields since the electrostatic lines of force must be cut at right angles and that further in the conductors a stronger current arose than was otherwise to be expected. This apparatus must therefore not only be regarded as a transformer, but also as an energy producer, with the difference that the excitation here is obtained instead of by means of electromagnets, by static fields of high pressure. The entire system may, to some extent, be compared with a dynamo in which the excitation takes place by means of a fixed constant magnet. It was further ascertained that this way of using the atmospheric electricity produced a sort of suction on the collector network, and that thus suitable greater quantities of current could be obtained.

The effects which in this apparatus became evident are extremely interesting and open a prospect of being able to obtain here a great deal more. Merely that these transformer made it possible to transform suitable quantities of atmospheric electricity into alternating current of high or lower frequency (without the use of spark gaps) shows already the extreme utility of these apparatus. Should in future, the construction of larger aggregates be necessary the transformer installation may be constructed in such a way that motors which are fed by a current obtained from an installation with spark gaps produce a certain quantity of energy which may then be employed for producing current according to the last described system.

The results of the examinations made for this may be construed as follows.

(1) If solid electrodes (condenser surfaces, rotor and stator surfaces) are employed they become hot. This effect may be considerably reduced by cutting the electrodes in ribbed form Figure 8, but not entirely removed. This form allows the surface of the condenser plate to be enlarged or increased; the electrodes may be fastened in a simple manner on the under frame by perforation 1, 2, 3, 4, 5.

Fig.8

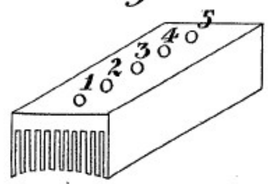
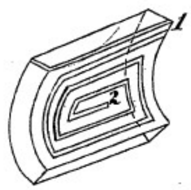


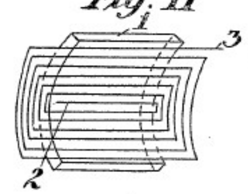
Fig. 9.



(2) If nicks or notches in spiral form as shown in Figure 9 seen from the side end in Figure 10 in section are employed, not only is the transformer effect greater but the poles yields also more current, but require greater quantities of energy for their movement than a simple commutator action would require.

Fig. 10

Fig. 11



(3) The greatest effect is obtained if the rotor and stator surfaces are wound in flat spiral form of suitably thick wire, and in such a way that the inductive effect combining with the capacity is calculated in suitable proportion and this result is adapted to a suitable periodicity. In practice this is preferably done by the wire bent in spiral form being inserted in a separate vulcanite or hard rubber mass (see Figure 11) so that a smooth pole surface is formed similar to that in phase motors.

Fig.12

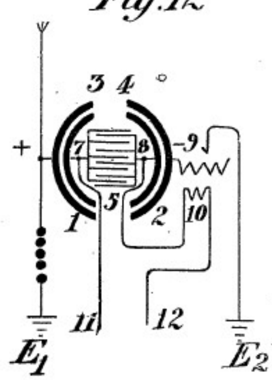
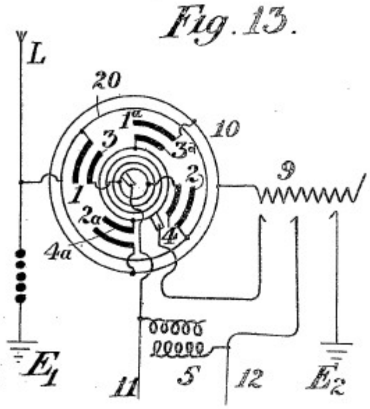


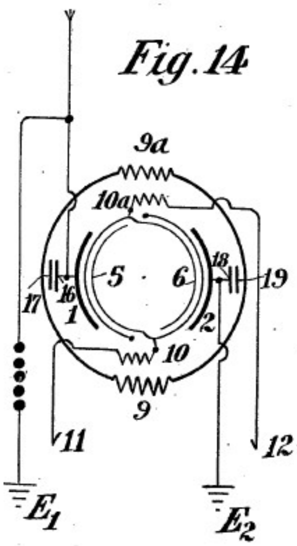
Fig.13.



Regular undamped oscillations of a high frequency may however be produced if the converter be carried out in the manner shown in Figure 13. The aerial wire L is metallically connected with the ring 20. To this two pole surfaces 1 and 2 are connected. The inductive earth pole is also connected with a second ring 10 from which again two, poles 1a and 2a are branched off. Of course in similar manner any suitable number of poles may be branched of. In similar manner there are in the rotor two poles fastened to one another (3 and 4 and 3a and 4a) connected with separate collector rings. From these two rings the current is collected by means of two brushes. The induced alternating current is however directly metallically connected with

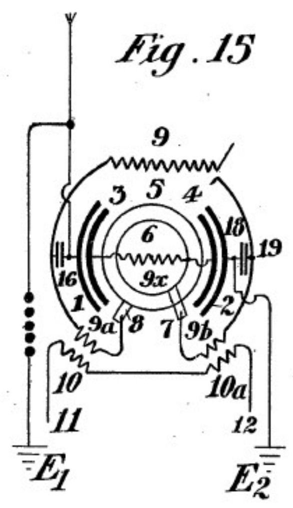
an inductive earth stator conductor over an induction coil 9. Further a combined inductance and capacity 5 is inserted between the two wires 11 and 12 in parallel with the converter. By this means a sparkless oscillatory circuit is obtained which can act on the exciting current in the stator. This produces however, a periodic alteration of the charging quantities according to the oscillation curves of the rotor currents in consequence of which the stator charge also commences with resonance oscillations and if the stator and rotor surfaces are calculated to one another in such a way that they are adapted to form oscillations of waves of similar length the entire converter is caused to oscillate and furnishes undamped oscillations of a high number of alternations, but of periodically changed amplitude, the form of which is dependent on the amplitude of the main alternating current and is caused by the number of the poles and revolutions per second. Thus an alternating current of, for example, 100 periods is formed, the separate periods of which are formed by undamped oscillations of a higher number of alternations. In Figures 14-16 four other diagrams of converters are illustrated, the object of which is not to produce usual alternating current, but oscillations of high frequency.

Fig. 14



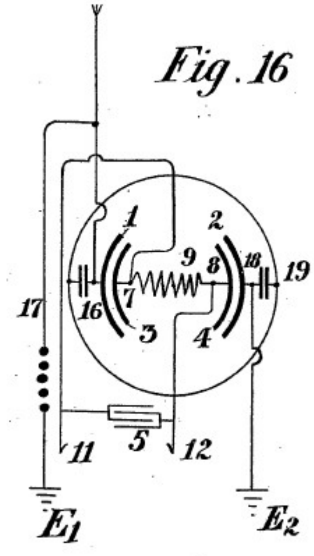
The main difference of these systems from those previously described is that from the connection of the collecting aerials is made between the stator pole 1 (Figure 14) and one pole 16 of the condenser 17 and the earth connection between a second stator pole 2 and the pole 18 of the condenser 19. The other poles of these condensers 17 and 19 are short circuited through a ring over two inductive primary coils 9 and 9a with one another. The secondary coils form the rotor conductors 10 and 10a. The rotor itself is constructed in the manner shown in Figure 6 of two short-circuited plate condensers which may be wound as shown in Figure 11. In similar manner of course the stator surfaces may also be formed. The collector rings of the rotor with the two brushes for collecting current are here not shown in order to simplify the drawings. By the connection of the two condensers in the exiting circuit of the converter and also by the action of the alternating current produced in the rotor on the stator circuit, with a correct calculation of the capacity and the self-induction co-efficients a maximum action may be obtained. The kind of current produced will be similar to that described for Figure 12.

Fig. 15



The novelty of the converter illustrated in Figure 15 consists mainly in that the current resulting in the rotor is not directly employed, but only serves a exciter of the primary coils 9a and 9b. The working current is produced in the secondary coils 10 and 10a and further conducted through the conductors 11 and 12. The stator current may be brought by the regulatable inductive resistance 9 to the same resonance as the rotor current.

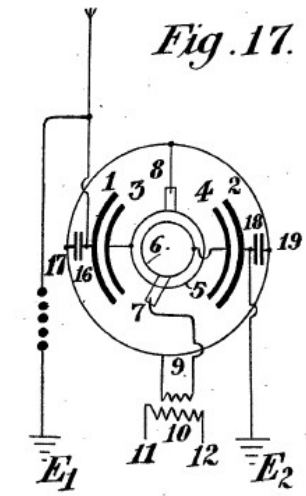
Fig. 16



In Figure 16 a very similar system is shown to Figure 14. The condenser 5 is however connected in parallel with the converter; and by the inductive resistance constructed in the rotor a short circuited oscillatory circuit is formed which gives extraordinarily good results and is simple in construction.

The inductive resistance 9 may also instead of being constructed in the rotor be constructed as primary coil employed outside the rotor and short circuit the oscillatory circuit over the stator surfaces (see Figure 17).

Fig. 17.



The last six types serve only for producing oscillations of a high number of alternations. If it be desired to obtain ordinary alternating current there complicated constructional arrangements are not required as the types illustrated in Figures 1 to 11 suffice. It is self-evident that these arrangements may be altered in various ways by means of different condenser surfaces in practice.
Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is: --- [Claims not included here]